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Environmental Assessment

Waste Treatment Facility

OWMC
Ontario Waste Management Corporation

A provincial crown corporation.

OWMC TREATMENT FACILITY
PROCESS AREA REPORT
GENERAL FACILITIES

Prepared by
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November 1986

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Attention: Mr. R. V. Griffiths, P.Eng.
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Gentlemen,

OWMC Treatment Facility
Monenco Contract No.: MNC 8084-2

Process Area Report
General Facilities

We are pleased to submit herewith the draft report entitled: Process Area Report - General Facilities. The report describes the rationale for the selection of technologies including the conceptual design of the general facilities of OWMC's proposed Facility for the treatment and disposal of liquid industrial and hazardous waste in Ontario.

We trust that this report meets the Corporation's requirements.

Yours very truly,

J. V. Fitzgerald, P.Eng.
Project Manager

ITC/jj

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EXECUTIVE SUMMARY

PURPOSE OF THE REPORT

This report describes the rationale for the conceptual design of the general facilities of OWMC's proposed Facility for the treatment of liquid industrial wastes and hazardous wastes, which support the operation of the main treatment and disposal technologies.

General facilities provide the basic infrastructure which integrates the treatment and disposal technologies into a cohesive unit to treat Ontario's special waste in an environmentally safe manner. General facilities include systems which receive, store, analyse and transfer wastes within the plant, provide and distribute utilities such as electricity, and administer, protect and maintain the entire operation.

The background and rationale for the selection of treatment and disposal technologies for OWMC's Facility has been presented in earlier reports (Ref: The Proctor & Redfern Group[1], OWMC[2,3]). The choice of rotary kiln incineration, physical/chemical treatment, solidification and an engineered landfill as the four major components of the Facility was subsequently confirmed by A. D. Little of Canada Limited in their report entitled "Rationale for the Selection of Technologies for the Treatment and Disposal of Special Wastes in Ontario" - July 1985 (Ref: A. D. Little[4]).

This report focuses on the alternatives that were considered in establishing the design of the general facilities. The report describes the alternatives considered, the methodology used to compare them, and the results of the evaluation process. The report also describes how the resultant design has been optimized to maximize the performance, safety, reliability and flexibility of the complete Facility operation.

This process area report is one of five such reports which together cover all areas of OWMC's proposed treatment Facility. These reports provide additional technical backup data and information in support of the system design and operating description presented in the Facility Description report (Ref: Monenco Limited[5]). Process area reports for Incineration, Physical/Chemical Treatment, Solidification and Engineered Landfill are contained in separate Process Area Reports (Ref's: Monenco Limited[6,7,8,9]).

This report was prepared for OWMC by Monenco Limited, who are also responsible for preliminary engineering of the overall treatment Facility. The technical expertise of the following Consultants is recognized for their input to, and the design and operating philosophies of the general facilities systems:

- o Environmental Elements Corporation, Baltimore, Maryland, U.S.A.
- o Von Roll Limited, Zurich, Switzerland
- o Hessische Industriemüll GmbH (HIM), Wiesbaden, West Germany
- o MM Dillon Ltd., Toronto, Canada
- o J.R. Conner Technologies, Atlanta, Georgia, U.S.A.

The work of Reed Stenhouse Limited, International Insurance Brokers, is also recognized for contributions in reviewing the philosophy and design development of loss control measures and the fire protection system.

SCOPE AND METHOD

The methodology used to evaluate alternative design options in the general facilities area differs from that used in the main process areas (Ref: Monenco Limited[6,7,8,9]), where detailed evaluations were undertaken involving the use of a numerical scoring system and weighting factors for each evaluation criteria.

The majority of the general facilities are support systems, whose functions are determined by the requirements of the main process areas. In developing the design of the general facilities area, the identification and evaluation of alternatives was often conducted through discussions during design meetings between Monenco and OWMC staff. Input was also obtained from the consultants referred to earlier.

The following points summarize the general methodology used to evaluate the alternatives.

- o Establish objectives and key philosophies for each component of the general facilities.
- o Establish criteria for the assessment of alternatives.
- o Establish specific requirements or design criteria, for each component of general facilities.
- o Identify alternatives for consideration.
- o Evaluate the relative suitability of each alternative according to the established criteria, and select the preferred alternative for inclusion in the conceptual design.

While cognizance was taken of the criteria for the evaluation of alternatives, detailed evaluations involving a numerical scoring system and weighting factors for each of the evaluation criteria were not undertaken.

PREMISES AND POSTULATES

OWMC has developed the following basic planning principles and guidelines which are central to technology selection in all areas of the proposed treatment Facility including the general facilities.:

- Wastes must undergo treatment to the fullest extent possible, using the best available proven technologies, prior to the safe disposal of the remaining treatment residues.

- It is the Corporation's goal, in order of priority, to:
  - minimize risk to human health,
  - minimize environmental impacts, and
  - minimize financial costs to OWMC and the people of Ontario.

The following additional premises provided by OWMC have been used as starting points for technology selection in the conceptual design of the Facility:

- OWMC's Treatment Facility will be designed as an integrated Facility, located in the Township of West Lincoln, in The Regional Municipality of Niagara.

- The Treatment Facility will be designed with an initial capacity of 150 000 t/a, with provisions for future expansion up to 300 000 t/a if required. The initial capacity of 150 000 t/a of special waste would consist of approximately 30 000 t/a of organic waste and 120 000 t/a of inorganic waste.

- Variations in the types and quantities of special wastes requiring treatment at OWMC's Treatment Facility may result from:
  - effectiveness of OWMC's 4R program, which is to encourage industry in Ontario to reduce, recover, recycle and reuse industrial waste,
  - industry's response to market demands and to financial constraints,
  - process and manufacturing changes, and
  - changes in provincial waste regulations.

- Due to expected variations in the types and quantities of special wastes requiring treatment at OWMC's Treatment Facility, it is necessary that the Facility conceptual design incorporate features such as:
  - maximum flexibility,
  - future expansion capability, and
  - reserve storage and treatment capacity.

- No wastes will normally be accepted at the Facility unless they have been previously tested and analysed by OWMC's laboratory to determine their physical and chemical characteristics, to identify the treatment processes required and to establish how and when the waste will be shipped to the Facility for treatment. This does not preclude exceptional circumstances such as the emergency clean-up of spills or instances where it is safer to store hazardous waste at OWMC's Facility than elsewhere, pending determination of treatment and disposal methods.

- A technical buffer zone is to be provided to maintain a distance of approximately 400 m between sources of accidental emission release within the Facility and OWMC's property boundary. (Ref: Dillon[10]).

- Excess treated effluent from the physical/chemical treatment plant will be evaporated and discharged to atmosphere as steam, whilst residues will be solidified prior to disposal in the engineered landfill.

- Operating hours will be:

General Office	8 a.m. - 5 p.m. Monday to Friday
Waste and Reagent Receiving	7 a.m. - 4 p.m. Monday to Friday
Main Laboratory	7 a.m. - 5 p.m. Monday to Friday
Incineration Plant	Continuous 24 h, 7 day/week
Physical/Chemical and Solidification Plants	8 h daytime operation rising to a continuous 24 h through Monday to Friday

Physical/Chemical Laboratory	As for Physical/Chemical Plant
Landfill	Daylight hours only within period 7 a.m. - 7 p.m. Monday to Friday

- Waste deliveries will be pre-scheduled.

- Waste will normally be analysed, characterized and have treatment method specified prior to being authorized for delivery.

- For a fee, payable by the hauler, any bulk hazardous waste carrying vehicle will be internally washed.

- Pre-investment to accommodate the expansion of the general facilities systems to the ultimate Facility requirements will be minimized.

- Only proven technologies will be considered for general facilities systems. For this application, technologies will be considered proven if they have performed satisfactorily for a period of at least one year on a similar scale and in a similar application.

- Bulk tanker loads of special wastes delivered to the Facility are expected to range in size from 10 t to 40 t with an average of approximately 15 t.

Postulates are assumptions or hypotheses which have been made by Monenco that are basic to the approach used to evaluate alternatives and arrive at an optimum process design. The key assumptions, system objectives and philosophies which have influenced technology evaluations and conceptual design are summarized by the following points:

- At least two engineered containment levels are to be provided for storage of wet/pumpable wastes as a protection against leaks or spills. This is in addition to the natural containment provided by the site and its underlying clay.

- o All surface drainage is to be checked and treated, if necessary, prior to discharge.

- o On-site laboratory facilities are to be capable of being used in defining treatment procedures, performing sampling and analysis of waste to ensure safety of Facility operation, health and safety of the general public and protection of the environment.

- o A computerized data management system (DMS) will be provided to store the amount of information involved in the Facility operation.

STATUS OF DATA

The waste profile developed by OWMC is typical, and the design of the general facilities recognises that the nature and quantities of various waste types which will be sent to OWMC's Facility for treatment can change throughout its operating life.

Much of the data used in the conceptual design development of the general facilities, including the consideration of alternatives, is based on information from current literature, similar operating facilities, technology vendors and codes and regulations.

MAIN FINDINGS

The general facilities for the OWMC Treatment Facility will include the following main feaures. These have been selected in accordance with OWMC's three goals.

- A facility layout which will accommodate the receipt, unloading, storage and treatment of Ontario's special waste in a safe, efficient, and reliable manner, while maintaining flexibility to accommodate future expansion of the Facility, if required.

- Safety and security features involving engineered containment systems, fire protection systems and plant security systems which will minimize risk to human health and impact on the environment as well as protect Ontario's investment from potential consequences of unauthorized access.

- Waste unloading systems which can safely and efficiently unload and transfer to storage a wide range of wastes expected at OWMC's Facility.

- A tank farm and storage tank facilities for the safe and separate storage of organic and inorganic waste respectively, pending treatment.

- Facilities for the safe and efficient receipt, sampling, storage and processing of organic and inorganic waste delivered to the Facility in drums and miscellaneous containers.

- Laboratory facilities designed for the determination of the characteristics of waste proposed for treatment and to define guidelines for their safe and efficient shipment, receipt, sampling, unloading, handling, storage and treatment. The laboratory will also conduct tests to ensure that the treatment objectives are being achieved.

- A modern computerised data management system for safe, efficient planning, coordination and management of the overall operations of the Facility, and process control systems for the control and monitoring of treatment processes and related safety systems.

- Electrical distribution systems and associated lighting, communications and safety systems designed in accordance with pertinent codes and practices, including emergency and uninterruptible power supply systems which will ensure the safety of operations during power failure.

- Servicing of the site with raw water, surface water discharge, fuel and electrical power, in a manner which best meets OWMC's goals of minimizing both environmental impact and cost.

- Utility systems consisting of services distributed throughout the site to supply the needs of process areas and ancilliary buildings in a safe, reliable, flexible, efficient and cost effective manner, including the environmentally safe management of surface water from the central operating area.

- Vent emission control systems designed to minimize the release of contaminants to the environment from vent gas and exhaust air from process equipment and process building areas of the Facility.

- Buildings and facilities such as the administration building, gatehouse, and maintenance facilities which are ancillary to, but essential for, the operation of OWMC's Facility.

Overall, the general facilities of OWMC's treatment Facility will support and complement the main process areas in treating Ontario's waste in a highly effective manner which will thereby minimize risk to human health and impact on the environment.

CHAPTER 1
INTRODUCTION

1.1 PURPOSE OF THE REPORT

This report describes the rationale for the conceptual design of the general facilities of OWMC's proposed Facility for the treatment of liquid industrial wastes and hazardous wastes, which support the operation of the main treatment and disposal technologies.

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results of the evaluation process. The report also describes how the resultant design has been optimized to maximize the performance, safety, reliability and flexibility of the complete Facility operation.

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Chapter 2 of the report summarizes the policies and objectives of OWMC, identifies the types of wastes that are expected to be received, stored, and treated at the Facility, and the basic assumptions (premises and postulates) which have governed the evaluation and design of general facilities. It also addresses the evaluation of alternatives considered in the general facilities area of the plant.

Chapters 3 to 13 address the various parts of the Facility referred to as general facilities and examine the design development process, including the consideration and evaluation of alternatives, and a description of the proposed design. Specific parts of the general facilities, and the chapters in which they are addressed, are as follows:

o Facility Layout	Chapter 3
o Safety and Security	Chapter 4
o Bulk Waste Unloading and Truck Wash	Chapter 5
o Tank Farm and Storage Tank Area	Chapter 6
o Drum Handling	Chapter 7
o Laboratories	Chapter 8
o Data Management System and Process Control	Chapter 9
o Electrical Systems and Communications	Chapter 10
o Site Services and Utility Systems	Chapter 11

- o Vent Emission Control Systems — Chapter 12
- o Buildings and Structures — Chapter 13

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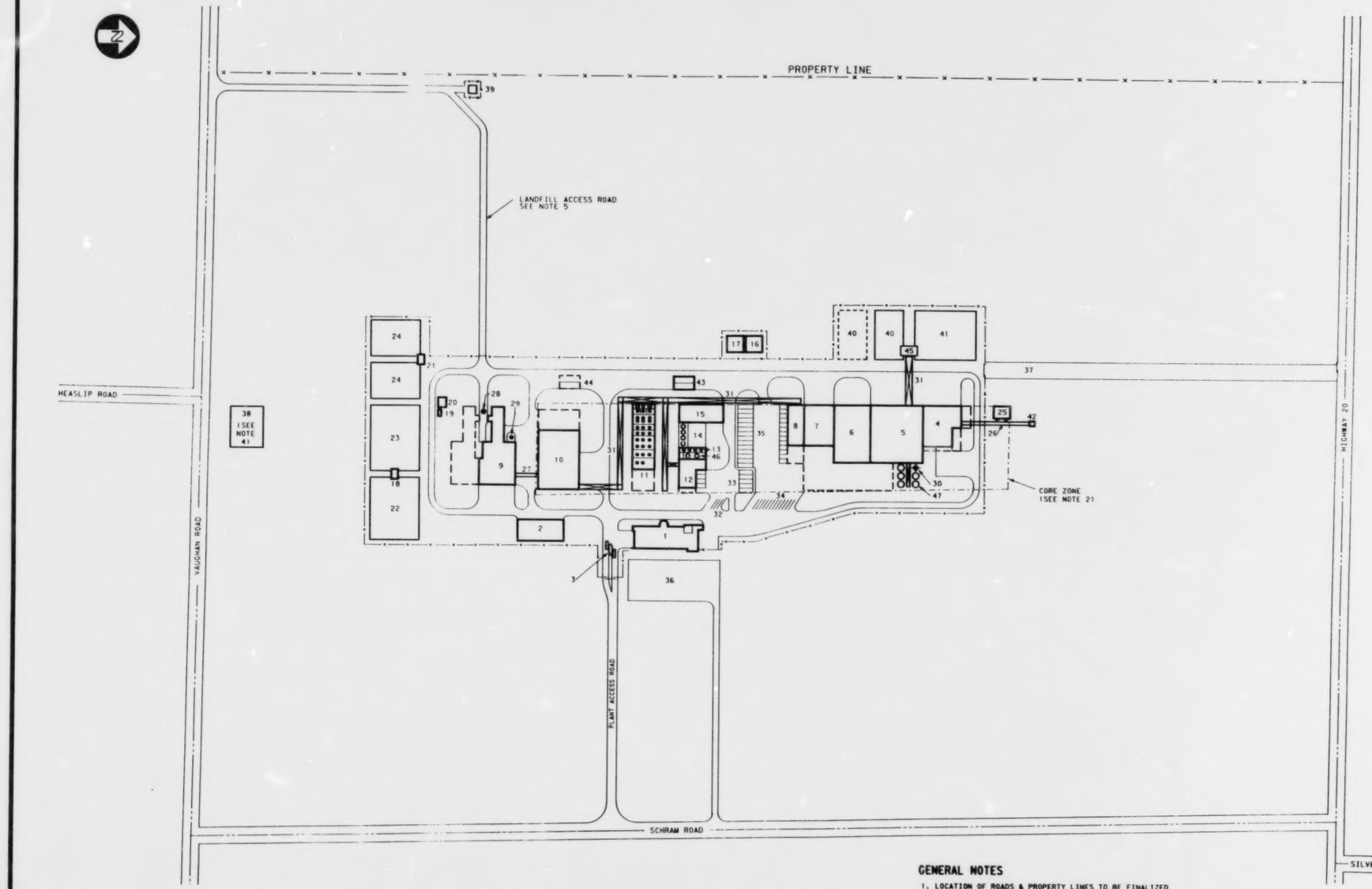
- o Hessische Industriemüll GmbH (HIM), Wiesbaden, West Germany
- o MM Dillon Ltd., Toronto, Canada
- o J.R. Conner Technologies, Atlanta, Georgia, U.S.A.

The work of Reed Stenhouse Limited, International Insurance Brokers, is also recognized for contributions in reviewing the philosophy and design development of loss control measures and the fire protection system.

1.2 FACILITY DESCRIPTION

The general facilities addressed in this report support the operation of the treatment and disposal technologies comprising incineration, physical/chemical treatment, solidification and engineered landfill.

Figure 1 identifies how the Facility is located on the site. The treatment technologies, supported by the general facilities, are located in a central operating area which occupies approximately 20 hectares (ha) of the 124 ha site. This operating area is centrally located on the site and surrounded by an area designated for landfill operations, to provide an effective buffer zone of approximately 400 m between sources of accidental emission release in the central operating area, and the property boundary. (Ref: Dillon[10]).



LEGEND

1. ADMINISTRATION BUILDING
2. MAINTENANCE BUILDING
3. GATEHOUSE & WEIGH SCALES
4. SOLIDIFICATION PLANT
5. PHYSICAL/CHEMICAL TREATMENT PLANT
6. PHYSICAL/CHEMICAL STORAGE TANK AREA
7. INORGANIC DRUM STORAGE & HANDLING BUILDING
8. INORGANIC TANK TRUCK UNLOADING AREA
9. INCINERATION PLANT
10. ORGANIC DRUM STORAGE & HANDLING BUILDING
11. INCINERATOR TANK FARM
12. ORGANIC TANK TRUCK UNLOADING AREA
13. INCINERATOR WASTE RECEIVING TANKS
14. SEGREGATED ORGANIC STORAGE TANK AREA
15. STORAGE BUILDING
16. MAIN SUBSTATION
17. EMERGENCY POWER STATION
18. SURFACE WATER PUMPHOUSE
19. SANITARY SEWAGE PLANT
20. RAW WATER TREATMENT PLANT
21. FIREWATER PUMPHOUSE
22. SURFACE WATER POND (POTENTIALLY CONTAMINATED
23. SURFACE WATER POND (UNCONTAMINATED)
24. FIREWATER POND
25. SOLIDIFIED MATERIAL INTERIM STORAGE BUILDING
26. SOLIDIFIED MATERIAL CONVEYOR
27. DRUM CONVEYOR
28. INCINERATOR STACK
29. AUXILIARY BOILER STACK
30. EVAPORATOR STACK
31. PIPERACK
32. TEMPORARY TRUCK HOLDING AREA (ORGANIC)
33. TRUCK HOLDING AREA (ORGANIC)
34. TEMPORARY TRUCK HOLDING AREA (INORGANIC)
35. TRUCK HOLDING AREA (INORGANIC)
36. CAR PARK
37. EMERGENCY ROAD, HYDRO & GAS CORRIDOR
38. LANDFILL STORM DETENTION POND
39. METEOROLOGICAL/AIR MONITORING STATION
40. RECYCLE WATER POND
41. EVAPORATOR FEED POND
42. TRUCK LOAD OUT STATION
43. TRUCK WASH STATION
44. TRUCK WASH STATION (FUTURE)
45. EVAPORATOR/RECYCLE PUMP HOUSE
46. FUEL OIL TANKS
47. EFFLUENT STORAGE TANKS

GENERAL NOTES

1. LOCATION OF ROADS & PROPERTY LINES TO BE FINALIZED FOLLOWING CONFIRMATION BY AERIAL AND/OR LEGAL SURVEY
2. CORE ZONE IS DEFINED AS AN ENVELOPE 400M FROM THE SITE BOUNDARIES, AS ESTABLISHED BY OWMC
3. RAIL CORRIDOR NOT SHOWN
4. SIZE & LOCATION OF LANDFILL STORM DETENTION POND TO BE CONFIRMED
5. EXACT LOCATION OF LANDFILL ACCESS ROAD TO BE DETERMINED

FIGURE 1

SITE PLAN

The arrangement of the central operating area is shown on Figure 6 (p. 34).

It is useful to understand the treatment philosophy which governs the design of OWMC's treatment facility. This is provided in the following paragraphs, additional information being available in the Facility Description report (Ref: Monenco Limited[5]) and in other Process Area Reports (Ref: Monenco Limited[6,7,8,9]).

Incineration Plant

Organic special wastes delivered to the Facility for treatment and disposal will be destroyed by high temperature thermal oxidation using the rotary kiln incineration plant.

The incineration plant will include provisions for cooling the gaseous products of combustion (flue gases) and for treating the cooled flue gases to remove contaminants, prior to the cleaned gases being discharged to the atmosphere via a stack.

Inorganic residues from the incineration plant will be disposed of as follows:

- Solidified slag from the rotary kiln incinerator will be disposed of in the engineered landfill.

- Solid residues from the waste heat recovery boiler (i.e. ash), spray dryer and electrostatic precipitator (i.e. salt/flyash) will be further processed in a dedicated solidification plant and then disposed of in the engineered landfill.

In addition, the incineration plant will be capable of destroying:

- Organic contaminants which are recovered from aqueous organic wastes in the physical/chemical treatment plant.

- o Aqueous organic wastes containing low concentrations of organics directly, should these wastes not be amenable to treatment by physical/chemical processes.

- o Any organic contaminants delivered to the Facility, whether they be solid or liquid, pumpable or non-pumpable, in concentrated raw wastes or bound in primarily inorganic residues arising from physical/chemical treatment processes, or even trace organic contaminants of concern remaining in the treated effluent following physical/chemical treatment; if so required in order to protect human health and the environment.

Physical/Chemical Treatment Plant

Inorganic special wastes delivered to the Facility for treatment, or produced on site, will be chemically stabilized, detoxified and/or concentrated in the physical/chemical treatment plant.

The physical/chemical treatment plant will also include provisions for treating:

- o Contaminated surface drainage from all parts of the Facility.

- o Leachate from the engineered landfill if contaminated.

- o Aqueous organic wastes delivered to OWMC's Facility for treatment, or produced on site, which contain low concentrations of organic contaminants.

Treated effluent from the physical/chemical treatment plant will be reused on site to the maximum extent possible. Excess treated effluent will be discharged from the Facility by evaporation, with the steam being discharged to atmosphere via a stack.

Should treated effluent not meet the treatment objectives established for reuse on site or for evaporation to atmosphere, then it may be:

- o retreated,
- o solidified and disposed of in the engineered landfill, or
- o incinerated,

depending on the nature of the contaminant and reason for the treatment objectives not being achieved in the first place.

Residues from the physical/chemical treatment plant will be disposed of as follows:

- o Organic contaminants recovered from aqueous organic wastes will be incinerated.

- o Filter cake containing organic contaminants will be incinerated.

- o Inorganic residues will be solidified and placed in the engineered landfill.

Solidification Plant

The primary inorganic residues from the physical/chemical treatment plant and the incineration plant will be treated by a solidification process.

The solidification plant will include provision for treating dry inorganic solids and wet non-pumpable residues from generators, when such residues do not require further physical/chemical treatment.

During periods when the polishing treatment stage of the physical/chemical treatment plant is shut-down, when internal effluent recycle demands are low due to incineration plant shut-down or if the treated effluent cannot be disposed of for any reason, the resulting effluents can be solidified.

The solidification processes will produce a material suitable for disposal in the engineered landfill. This material will be both physically

and chemically stable, so minimizing the level of residual contaminants which could dissolve in water (leaching) due to infiltration of water into the engineered landfill.

Engineered Landfill

Slag from the incineration plant and solidified material from the solidification plant will be placed in the engineered landfill.

No hazardous waste will be placed untreated into the engineered landfill.

CHAPTER 2
DESIGN BASIS AND SYSTEM DEVELOPMENT

2.1 INTRODUCTION

An important aspect in the evaluation and selection of appropriate components for the general facilities of OWMC's Facility is to define, to the extent possible, the framework within which the selected components are expected to operate. This framework is defined by:

- o OWMC's philosophy,
- o the types and quantities of waste to be handled at OWMC's Facility (Waste Profile),
- o objectives, philosophies (premises) and assumptions (postulates) applied to the design of the general facilities to respond to the requirements of the major process areas.

2.2 OWMC PHILOSOPHY

OWMC has developed basic planning principles and guidelines which are central to technology selection in all areas of the proposed treatment Facility including the general facilities. The following points summarize these key treatment philosophies:

- o OWMC's primary responsibility is to establish and operate a liquid industrial waste and hazardous waste management system in Ontario. It has no responsibility for managing municipal solid waste or

radio-active waste, nor is it a regulator of other industrial waste management systems.

- o OWMC Facilities, no matter how large or small they ultimately may be, must be designed to handle all types of special waste. This full service capability is inherent in OWMC's responsibility as a provincial crown agency.

- o Wastes must undergo treatment to the fullest extent possible, using the best available proven technologies, prior to the safe disposal of the remaining treated residues.

- o The initial Facility should be capable of expansion through designs that provide for new construction and equipment that allows for modular expansion, and technologies that favour increased capacity through increased operating hours, wherever practical, rather than new construction of additional facilities.

- o It is the Corporation's goal, in order of priority, to:
  - minimize risk to human health,
  - minimize environmental impacts, and
  - minimize financial costs to OWMC and the people of Ontario.

2.3 WASTE PROFILE

OWMC commissioned a study on waste in Phase 1 of the Facilities Development Process which proposed a classification of Ontario special waste and estimated the types and quantities of each (Ref: OWMC[2,3,11], The Proctor & Redfern Group[12]). Additional work has subsequently been conducted to improve available data and to refine OWMC's assumptions on the quantities and characteristics of wastes it will be receiving for treatment and disposal. These most recent data have been used as a basis for ensuring

that the general facilities systems will have the necessary components, capacity and flexibility to respond to the waste treatment and disposal needs of industries in Ontario.

Table 1 summarizes the waste classes and quantities which are likely candidates for treatment by the technologies proposed for OWMC's Facility. The exact nature and quantities of the various waste types which will be sent to OWMC's Facility for treatment can change throughout its operating life.

For operational purposes, the physical state of the delivered waste has a major role in its handling and storage. The waste profile also identifies three main classifications of the physical state of the waste being delivered; each classification being applicable to both the inorganic and organic categories.

The delivery classifications are:

- o Pumpable liquids and sludges in bulk
- o Non-pumpables in bulk
- o Drums

Further sub-classification distinguishes between pumpable materials with or without gross solids, non-pumpables which are "dry" or "wet", and those having characteristics that warrant special handling and storage.

2.4 PREMISES

Premises are the information provided by OWMC or by other studies undertaken by the Corporation which have been taken as points of departure for new work. OWMC's basic principles and guidelines presented in Section 2.2 (p. 9) are premises which apply to the OWMC Treatment Facility as a whole.

TABLE 1
CANDIDATE WASTES FOR TREATMENT

OWMC CLASS	DESCRIPTION	TYPICAL TOTAL QUANTITY EXPECTED AT OWMC FACILITY (t/a)	TYPICAL WASTE QUANTITIES			
			ORGANICS TO INCINERATION (t/a)	INORGANICS TO PHYS/CHEM (t/a)		INORGANIC RESIDUES TO SOLIDIFICATION (t/a)
1	Organic Waste Sludges and Still Bottoms	11 050	9 580	1 470		0
2	Solvents and Organic Solutions	3 330	3 330	0		0
3	Oil and Grease	880	880	0		0
4	Oil and Water Mixtures	3 530	3 530	0		0
5	Organic and Oily Residues	6 030	3 790	2 240		0
6	Heavy Metal Solutions and Residuals	79 480	0	66 050		13 430(1)
7	Miscellaneous Chemicals and Products	3 100	860	2 240		0
8	Paint and Organic Residuals	5 030	4 750	280		0
9	Aqueous Solutions and Organics	1 790	600	1 190		0
10	Anion Complexes	1 070	0	1 070		0
11	Sludges and Inorganic Residuals	32 030	0	12 660		19 370(1)
12	Pesticide and Herbicide Waste	180	180	0		0
13	PCB Wastes	30	30	0		0
14	Clean Up Residuals	2 470	2 470	0		0
	TOTALS	150 000	30 000	87 200	120 000	32 800

Notes:

1. In many instances these are residues resulting from physical/chemical treatment at the waste generator's facility.
2. Residues from the physical/chemical treatment plant which require treatment by incineration, are omitted from the above table. These residues will be accommodated in the nominal capacity of the incineration system.
3. Waste quantities are derived from OWMC Waste Profile Information (November 1984) and are rounded off to the nearest 10 t/a.

The following additional premises have also been used as starting points for technology selection and the conceptual design of the Facility.

- o OWMC's Treatment Facility will be designed as an integrated Facility, located at the site in the Township of West Lincoln, in the Regional Municipality of Niagara.

- o The Treatment Facility will be designed with an initial capacity of 150 000 t/a, with provisions for future expansion up to 300 000 t/a if required. The initial capacity of 150 000 t/a of special waste would consist of approximately 30 000 t/a of organic waste and 120 000 t/a of inorganic waste.

- o Variations in the types and quantities of special wastes requiring treatment at OWMC's Treatment Facility may result from:
  - effectiveness of OWMC's 4R program, which is to encourage industry in Ontario to reduce, recover, recycle and reuse industrial waste,
  - industry's response to market demands and to financial constraints,
  - process and manufacturing changes, and
  - changes in provincial waste regulations.

- o Due to expected variations in the types and quantities of special wastes requiring treatment at OWMC's Treatment Facility, it is necessary that the facility conceptual design incorporate features such as:
  - maximum flexibility,
  - future expansion capability, and
  - reserve storage and treatment capacity.

- o No wastes will normally be accepted at the Facility unless they have been previously tested and analysed by OWMC's laboratory to determine their physical and chemical characteristics, to identify the treatment processes required and to establish how and when the waste will be shipped to the Facility for treatment. This does not

preclude exceptional circumstances such as the emergency cleanup of spills or instances where it is safer to store hazardous waste at OWMC's Facility than elsewhere, pending determination of treatment and disposal method.

- A technical buffer zone will be provided to maintain a distance of approximately 400 m between sources of accidental release within the Facility, and OWMC's property boundary. (Ref: Dillon[10])

- Excess treated effluent from the physical/chemical treatment plant will be evaporated and discharged to atmosphere as steam, whilst residues will be solidified prior to disposal in the engineered landfill.

- Operating hours will be:

General Office	8 a.m. - 5 p.m. Monday to Friday
Waste and Reagent Receiving	7 a.m. - 4 p.m. Monday to Friday
Main Laboratory	7 a.m. - 5 p.m. Monday to Friday
Incineration Plant	Continuous 24 h, 7 day/week
Physical/Chemical and Solidification Plants	8 h daytime operation rising to a continuous 24 h, through Monday to Friday
Physical/Chemical Laboratory	As for Physical/Chemical Plant
Landfill	Daylight hours only within period 7 a.m. - 7 p.m. Monday to Friday

- Waste deliveries will be pre-scheduled.

- Waste must be analysed, characterized and have treatment method specified prior to being authorized for delivery.

- A fee will be charged, payable by the hauler, for any bulk hazardous waste carrying vehicle that is internally washed.

- Pre-investment to accommodate the expansion of the general facilities systems to the ultimate Facility requirements will be minimized.

- Only proven technologies will be considered for general facilities systems. For this application, technologies will be considered "proven" if they have performed satisfactorily for a period of at least one year on a similar scale and in a similar application.

- Bulk tanker loads of special wastes delivered to the Facility are expected to range in size from 10 t to 40 t with an average of approximately 15 t.

2.5 POSTULATES

Postulates are assumptions or hypotheses which have been made by Monenco are basic to the approach used to evaluate alternatives and arrive at an optimum design. The key assumptions, system objectives and philosophies which have influenced technology evaluations and conceptual design are summarized by the following points:

- At least two engineered containment levels are to be provided for storage of wet/pumpable wastes as a protection against leaks or spills. This is in addition to the natural containment provided by the site underlying clay.

- All surface drainage is to be checked and if necessary, treated, prior to discharge from the site.

- On-site laboratory facilities are to be capable of being used for defining treatment procedures, performing sampling and analysis of waste to ensure safety of Facility operation, health and safety of the general public and protection of the environment.

- o A computerized data management system (DMS) will be provided to store the amount of information involved in the Facility operation.

2.6 SYSTEM DEVELOPMENT METHODOLOGY

The methodology used to evaluate alternative design options in the general facilities area differs from that used in the main process areas (Ref: Monenco Limited[6,7,8,9]), where detailed evaluations were undertaken involving the use of a numerical scoring system and weighting factors for each evaluation criteria.

The majority of the general facilities are support systems, whose functions are determined by the requirements of the main process areas. The objectives of each system, therefore, were compiled by assessing the extent of the process requirements at each interface and establishing basic criteria to meet these requirements. In many cases, system development involved the consideration of alternative design concepts or approaches, rather than technologies, as is the case in Process Area Reports for the main process areas.

Nevertheless, where alternative technologies are available for consideration in the design of general facilities, it was considered essential that only those technologies which have been used previously in similar full scale applications be given serious consideration. For this application, technologies are considered proven if they have performed satisfactorily for a period of one year on a similar scale and in a similar application.

The identification and evaluation of alternatives was often conducted through discussions during both formal and informal design meetings amongst Monenco staff and with OWMC. Input was obtained where appropriate, from consultants referred to on page 3.

The following points summarize the methodology used to evaluate alternatives in the development of general facilities for OWMC's Treatment Facility.

- o Establish objectives and key philosophies for each component of general facilities.
- o Establish criteria for the assessment of alternatives.
- o Establish specific requirements or design criteria, for each component of general facilities.
- o Identify alternatives for consideration.
- o Evaluate the relative suitability of each alternative according to the established criteria, and select the preferred alternative for inclusion in the preliminary process design.

The alternative conceptual system designs were evaluated having cognizance of the following evaluation criteria:

- o Performance
- o Safety
- o Flexibility
- o Reliability
- o Operational considerations
- o Economic and commercial considerations
- o Canadian benefits

The first four evaluation criteria (performance, safety, flexibility and reliability) were given higher priority in determining a preferred design best suited to the proposed Facility. This approach ensured that OWMC's corporate goals for the design of the Facility were being adhered to in the design of general facilities.

The manner in which the evaluation of alternatives is presented in this report is to ensure that the information is logical and readily understood. While cognizance was taken of the criteria for the evaluation of alternatives, detailed evaluation involving a numerical scoring system and weighting factors for each of the evaluation criteria were not undertaken.

The following paragraphs summarize the intent of the evaluation criteria used in the development of general facilities. While the criteria described herein were established for the evaluation of alternative process technologies, they are equally applicable in a general sense to many of the alternative system designs considered in the general facilities areas.

2.6.1 PERFORMANCE

This criterion recognizes and addresses two elements crucial to the establishment and operation of the Facility, namely that the designs selected:

- o are those which are able to most effectively achieve the specific requirements established for each component of general facilities, and

- o can be operated in a manner which is efficient in the use of energy and utilities.

This criterion also reflects the extent to which designs have been used elsewhere in similar full scale industrial applications.

2.6.2 SAFETY

Results of evaluation by the safety criterion are the most obvious means by which OWMC measures the degree to which a design or technology achieves its first two corporate goals; to minimize risk to human health and to minimize impact on the environment.

2.6.3 FLEXIBILITY

One of the premises which guided the design was a requirement that the Facility have maximum flexibility to treat a wide range of wastes. This requirement is based on the knowledge that wastes received at OWMC's Facility will cover a broad spectrum of both physical and chemical forms. The flexibility criterion therefore reflects the need to achieve OWMC's objectives of minimizing risk to human health and impact on the environment for a wide range of waste types and characteristics. It also assesses the ability of technologies and/or designs to easily and safely handle variations in quantities of waste requiring treatment.

2.6.4 RELIABILITY

The reliability criterion measures the ability of designs to achieve anticipated results on a consistent basis. This criterion focuses on the physical components of potential technologies and/or designs, the extent of their maintenance requirements, the need for spare parts, the availability of reagents and spare parts, the general robustness of the design and its vulnerability to breakdown.

All of these factors influence the reliability of system designs and the ability of the Treatment Facility to achieve all three of OWMC's corporate goals.

2.6.5 OPERATIONS

The inclusion of this criterion is intended to reflect OWMC's desire to have a Facility which not only has the capability of treating special wastes to the highest practical standards, but also one which is highly operable in terms of its complexity and the extent to which it can be automated. The amount and availability of specialist startup assistance and operator training required for alternative designs is a further consideration.

This criterion therefore has a direct bearing on OWMC's ability to achieve its corporate goals once the Facility is in operation.

2.6.6 COMMERCIAL AND ECONOMIC

This criterion reflects, for the most part, one of OWMC's corporate goals; the desire to minimize the cost of the Facility. Although cost is perceived as one of the negative impacts of the Facility on Ontario, this criterion is given lower importance relative to criteria that measure the minimization of impact on human health and the environment.

2.6.7 CANADIAN BENEFITS

Alternative designs of technologies were examined to determine whether any benefits would be accrued to Canada, should one design or technology be selected over another. This criterion is a measure of the potential positive impacts of the Facility.

2.6.8 APPLICATION OF THE EVALUATION CRITERIA

In the application of the criteria outlined in the previous sub-sections for the evaluation of designs or technologies for the general facilities, performance, safety, flexibility and reliability were considered to be the criteria of greatest importance in view of OWMC's stated goals to minimize risk to human health, minimize environmental impacts and minimize financial costs to OWMC and the people of Ontario. Criteria relating to operations, commercial and economic considerations and Canadian benefits were considered of lower importance, consistent with these goals.

The relative importance of the various criteria identified above were used to guide the evaluation of alternatives. However, as previously explained, no detailed numerical evaluation was undertaken in determining preferred options for the general facilities area of OWMC's Facility.

CHAPTER 3
FACILITY LAYOUT

3.1 INTRODUCTION AND PURPOSE

The physical arrangement of various components of OWMC's Treatment Facility on the site is referred to as the Facility layout. The development of this layout followed a sequence of events similar to any other complex process plant, in that it was an evolutionary process led by Monenco Limited but involving input from OWMC's Project and Operations departments, and OWMC's loss control consultant, having due cognizance of the criteria established for design development (Section 2.6), namely:

- The layout must enable the various process components of incineration, physical/chemical treatment, solidification and landfill to interrelate and perform effectively in treating Ontario's wastes.

- The layout must ensure that the various Facility components interface and operate in a safe manner. The consideration of traffic movement to avoid potential onsite accidents which might result in releases of waste to the environment, or directly involve human safety, is an example of such considerations. The separation of certain process operations, to minimize the consequences of a major fire, is another.

- The layout must be flexible, to accommodate expansion of the initial operation to its ultimate proposed capacity, if required in the future. The layout must also reflect flexibility in

accommodating the various physical and chemical forms of waste in their receipt and handling at the site.

- The layout must support reliable operation of the various components. Again, the consideration of traffic movement is an example where the required sequence of events for receipt, sampling and unloading of wastes can be achieved in a consistent, reliable manner with minimum opportunities for operational error.

- The requirements of operations personnel must be reflected in Facility layout, to ensure that control centres are appropriately located relative to the process operations in their jurisdiction, to ensure that maintenance facilities are located close to the areas of greatest need, and that process operations which require the greatest operational interface are located physically as close as practical to one another.

- Costs to OWMC and Ontario can be minimized by arranging the various process components in a manner which reduces both capital and operating cost to the lowest practical level, consistent with good design practice.

3.2 DESIGN CRITERIA

The following fundamental criteria were established for developing a physical layout for the Facility:

- The main treatment operations will be located in the central part of the site, with the surrounding area being used for landfill operations. This reflects the concept of a technical buffer zone (Ref: Dillon[10]) wherein sources of accidental release are located approximately 400 m from the property line.

- The proposed location of the Facility is referred to herein as the site, the central part of the Facility housing the main treatment operations is referred to as the central operating area, and the area within the central operating area, which is prescribed by an imaginary line parallel to and approximately 400 m from the property line, is referred to as the core zone which is the area containing the potential source(s) of accidental release.

- Areas of the Facility which were designated as potential sources of accidental release and must, therefore, be located in the core zone, are as follows:

  - physical/chemical treatment plant
  - physical/chemical storage tank area
  - inorganic drum storage and handling building
  - inorganic tank truck unloading area
  - organic drum storage and handling building
  - incinerator tank farm
  - segregated organic storage tank area
  - organic tank truck unloading area
  - incinerator waste receiving tanks
  - storage building (for specific wastes)

- Traffic movement should be arranged to:

  - have vehicles enter and leave the site through a main gate as a security check,
  - have trucks weighed both entering and leaving the site,
  - have all site traffic travel in one direction, wherever practical,
  - minimize distances travelled by full vehicles while on site,
  - permit delivery of reagents by truck so as not to interfere with waste delivery vehicles,
  - provide separate entrances for vehicles delivering special waste and reagents, and those bringing personnel to the administration building,

- provide access roads to all areas for use by maintenance and/or emergency vehicles,
- provide a separate emergency access road to the central operating area i.e. one access road in addition to the main entrance,
- permit trucks delivering special waste or reagents to enter the operating facility at the most convenient locations.

o All onsite roads must be designed for the largest anticipated vehicle size of 40 t tanker capacity.

o Holding areas are required for waste delivery vehicles to await the results of verification laboratory analyses (fingerprint tests) conducted on samples of the waste consignment, prior to being authorized to unload their wastes at designated plant locations.

o Major components of the Facility should be located such that:

- the main laboratory is in the administration building to permit physical communication between office and laboratory staff while also being in a position close to the main entrance so that incoming truck contents are easily sampled by laboratory personnel,

- the gatehouse and weigh scales are at the main entrance to the central operating area, adjacent to the administration building for control purposes while maintaining reasonably close physical proximity to, and communication with, main offices,

- temporary truck holding areas are close to the laboratory for sampling and easy access by operations staff,

- the physical/chemical storage tank areas, and physical/chemical treatment plant are adjacent to each other due to the close process and operational interrelationships,

- the solidification plant is close to the physical/chemical treatment plant where practical, since it is an extension of the physical/chemical treatment plant, and processes significant quantities of residues from physical/chemical treatment,

- the solidification plant is as close as practical to the perimeter fence of the central operating area, to facilitate transfer of solidified residues to the landfill area,

- the organic drum storage and handling building is close to the incineration plant, to minimize the length of conveyors which transfer drums to the incineration plant for disposal,

- the complexity of interconnecting piping between the organic tank truck unloading area, the tank farm, and the incineration plant is minimized,

- surface water drainage, treated effluent and firewater ponds are located close to the point of service connection,

- the truck wash is located such that it can be accessed by vehicles requiring washing without affecting traffic flow,

- all building and facility spacings/clearances are in accordance with applicable regulations,

- plant facilities can be expanded to accommodate the ultimate proposed Facility capacity of 300 000 t/a, with minimal interference with the operating plant,

- the central operating area is no larger than necessary to meet the objectives stated herein, while meeting all applicable regulations, codes, and practices, and

- any rail spur on the site, if required in the future, will be located to facilitate delivery of reagents to the main process areas.

3.3 ALTERNATIVES CONSIDERED

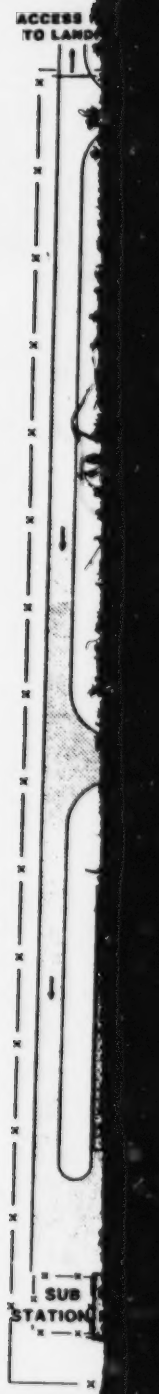
A significant amount of layout development work was conducted during Phase 4A of OWMC's Facilities Development Process, prior to the selection of the proposed site.

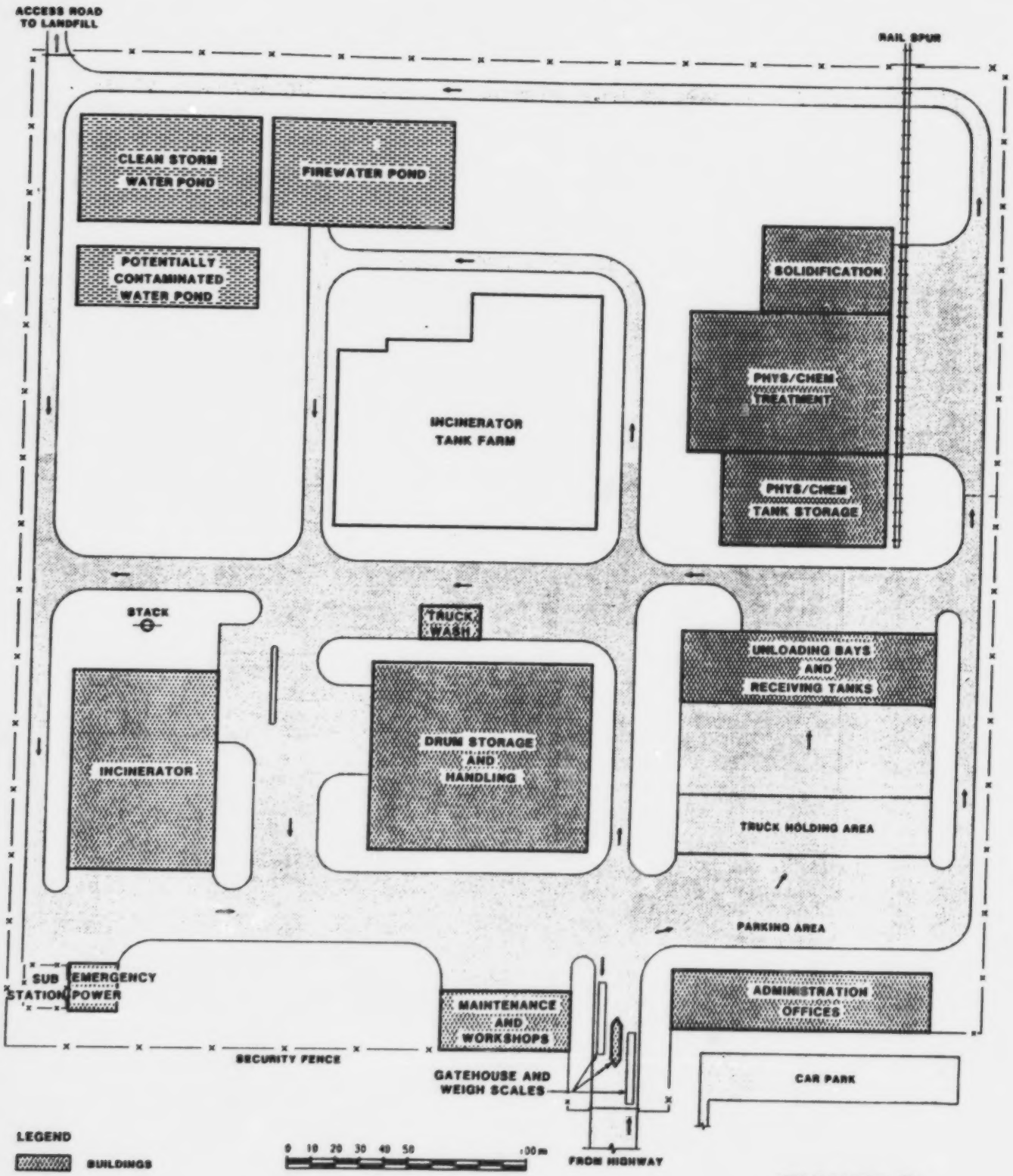
A generic modular layout was developed by preparing sketches of numerous alternatives and, using a block model as a tool, examining the relative merits of various options. The preferred option shown in Figures 2 and 3 was considered to accommodate the best combination of features reflected by the fundamental criteria identified in Section 3.2.

All but one of the siting options considered in Phase 4A of the Facilities Development Process (Ref: Monenco Limited[12]) could accommodate the generic modular layout. The rectangular shape of site LF-9C, however, could not accommodate this layout while maintaining the required buffer zone clearance of 400 m from the core zone to the property boundary.

For this reason, an alternative rectangular site layout was established specifically for the preferred site at West Lincoln. This layout, shown on Figures 4 and 5, also satisfies most of the criteria established in Section 3.2, with the following exceptions:

o truck holding areas are some distance from the main laboratory, and


ACCESS
TO LAND
SUB
STATION
LEGEND

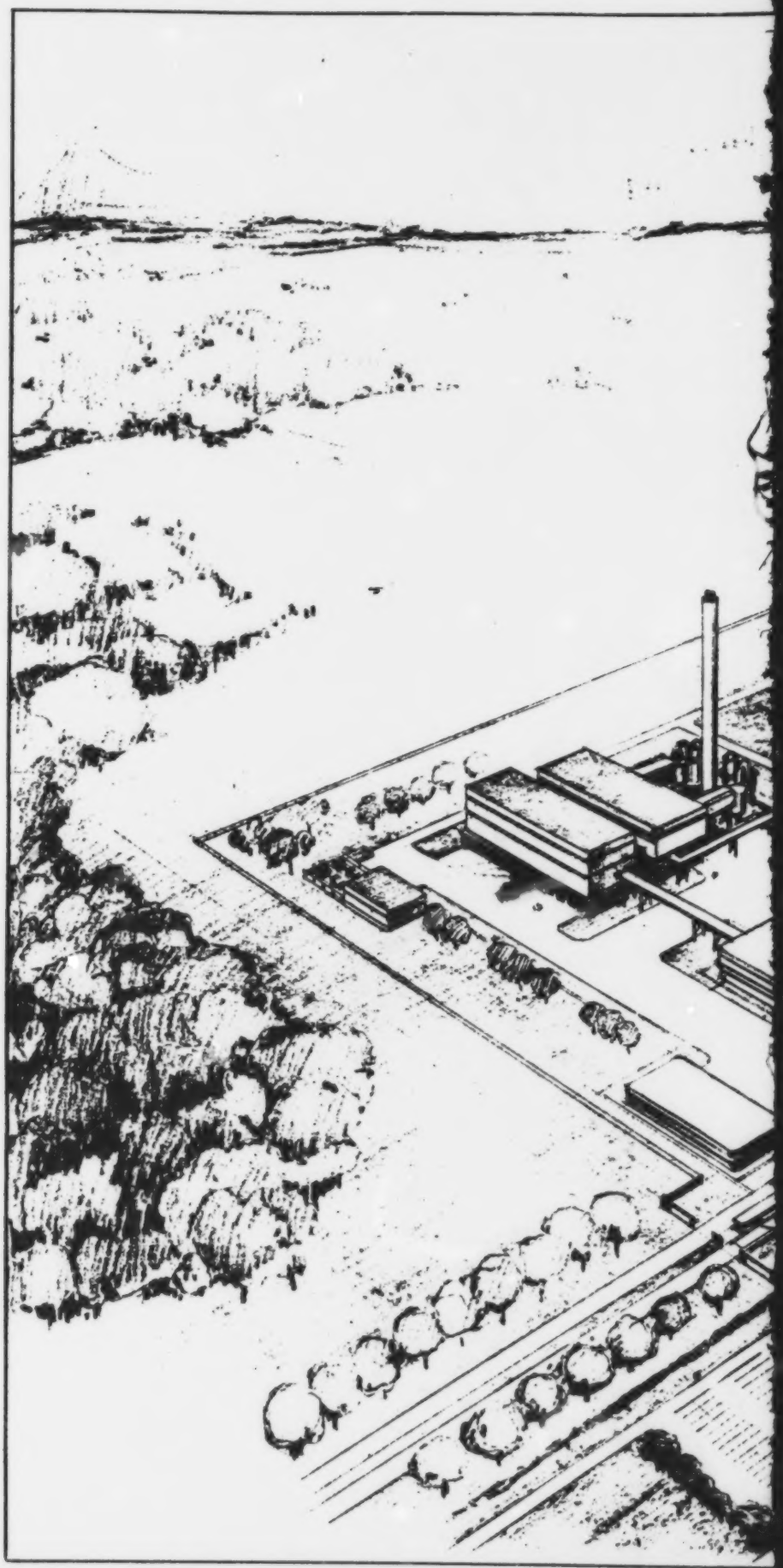


NOTES:

1. MAINTENANCE AND ADMINISTRATION BUILDINGS, GATEHOUSE AND CARPARK WILL BE LOCATED TO SUIT PREFERRED ACCESS ROAD
2. FOR ORIENTATION OF FACILITY SEE SITE LAYOUT OF SPECIFIC SITING OPTION

FIGURE 2

LAYOUT OF OPERATING AREA GENERIC MODULAR LAYOUT



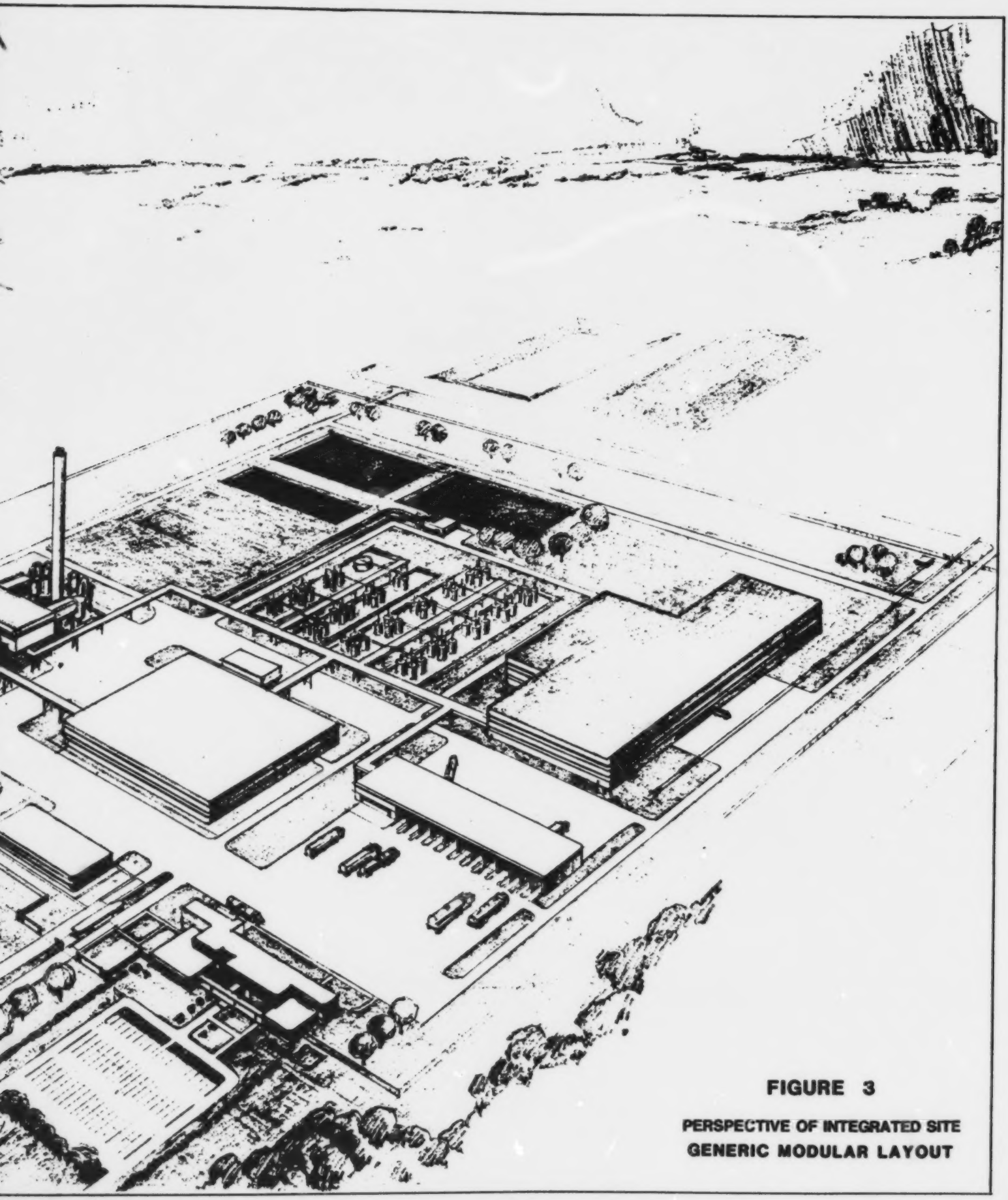
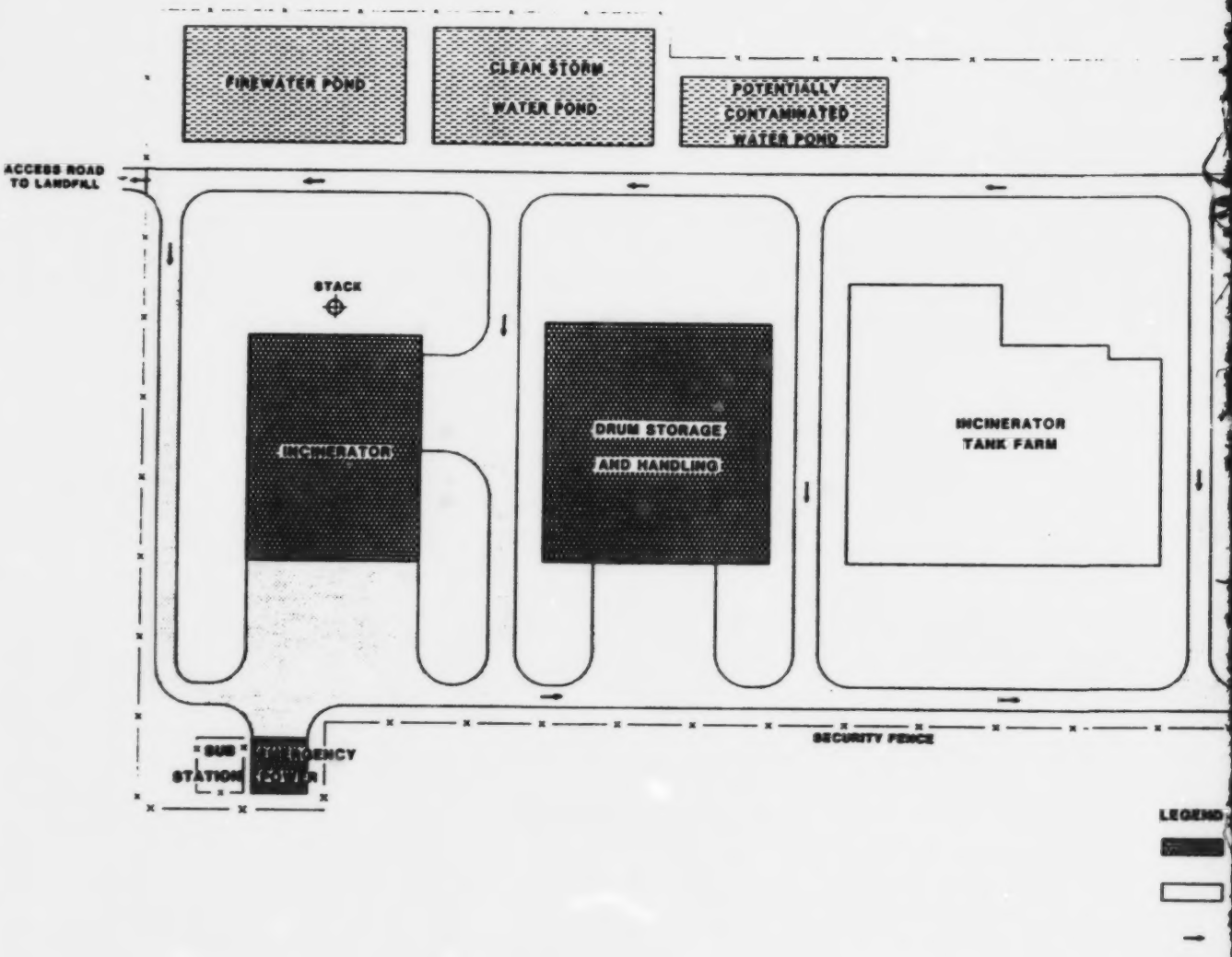


FIGURE 3

PERSPECTIVE OF INTEGRATED SITE
GENERIC MODULAR LAYOUT


FIREWATER POND
CLEAN STORM WATER POND
POTENTIALLY CONTAMINATED WATER POND
ACCESS ROAD TO LANDFILL
STACK
INCINERATOR
DRUM STORAGE AND HANDLING
INCINERATOR TANK FARM
SUB STATION
SECURITY FENCE
LEGEND

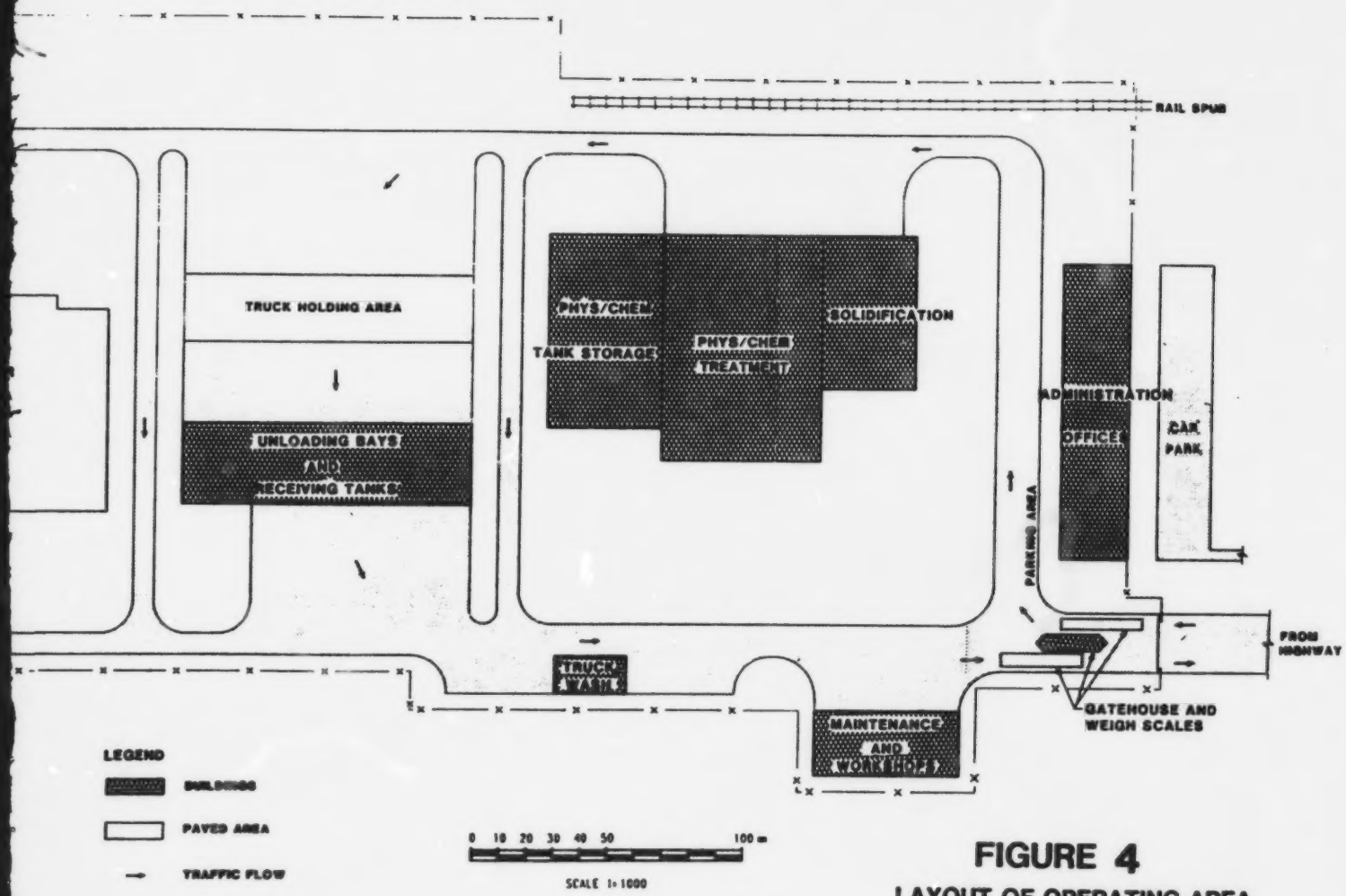
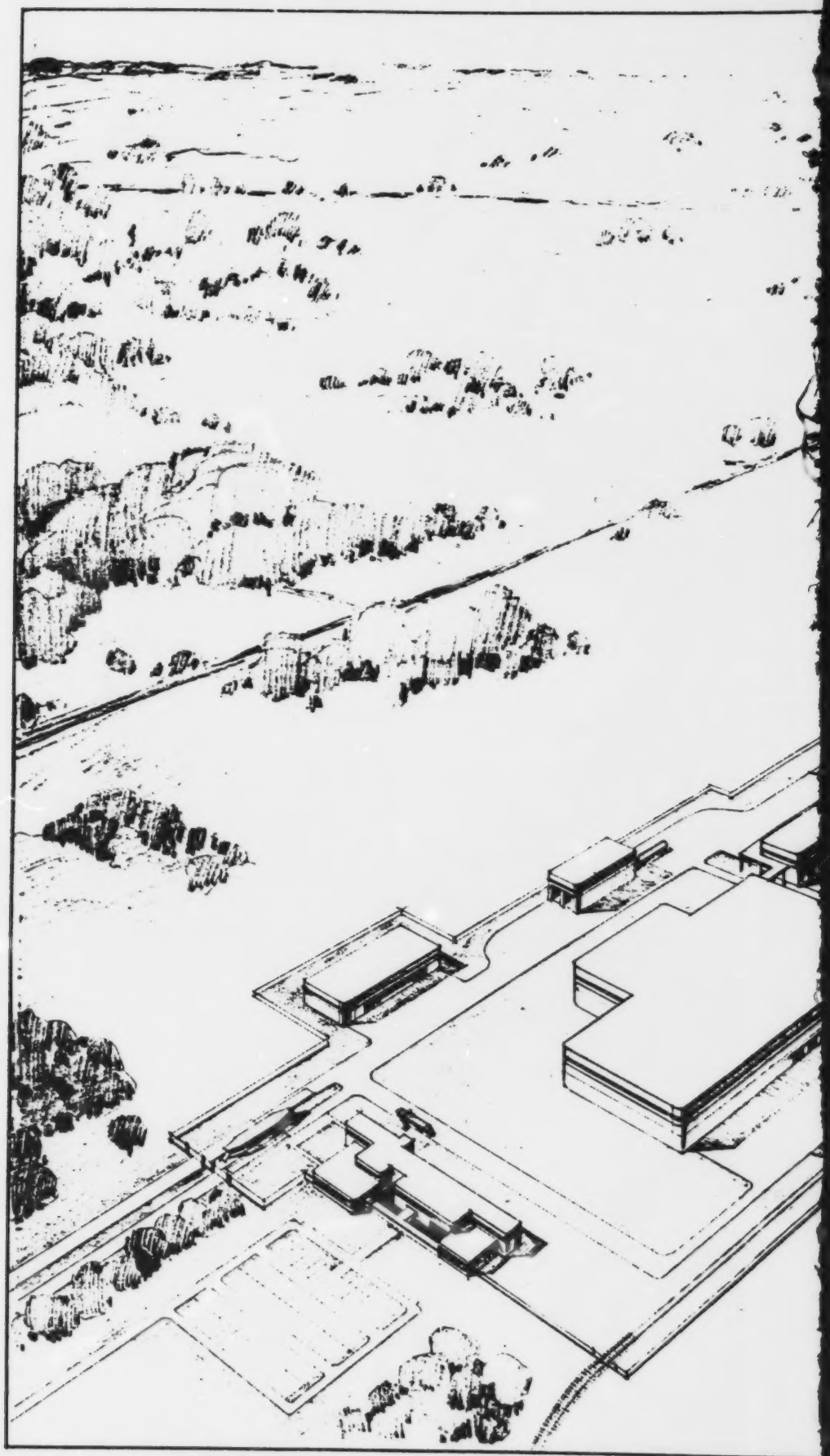


FIGURE 4

LAYOUT OF OPERATING AREA

LF-9C



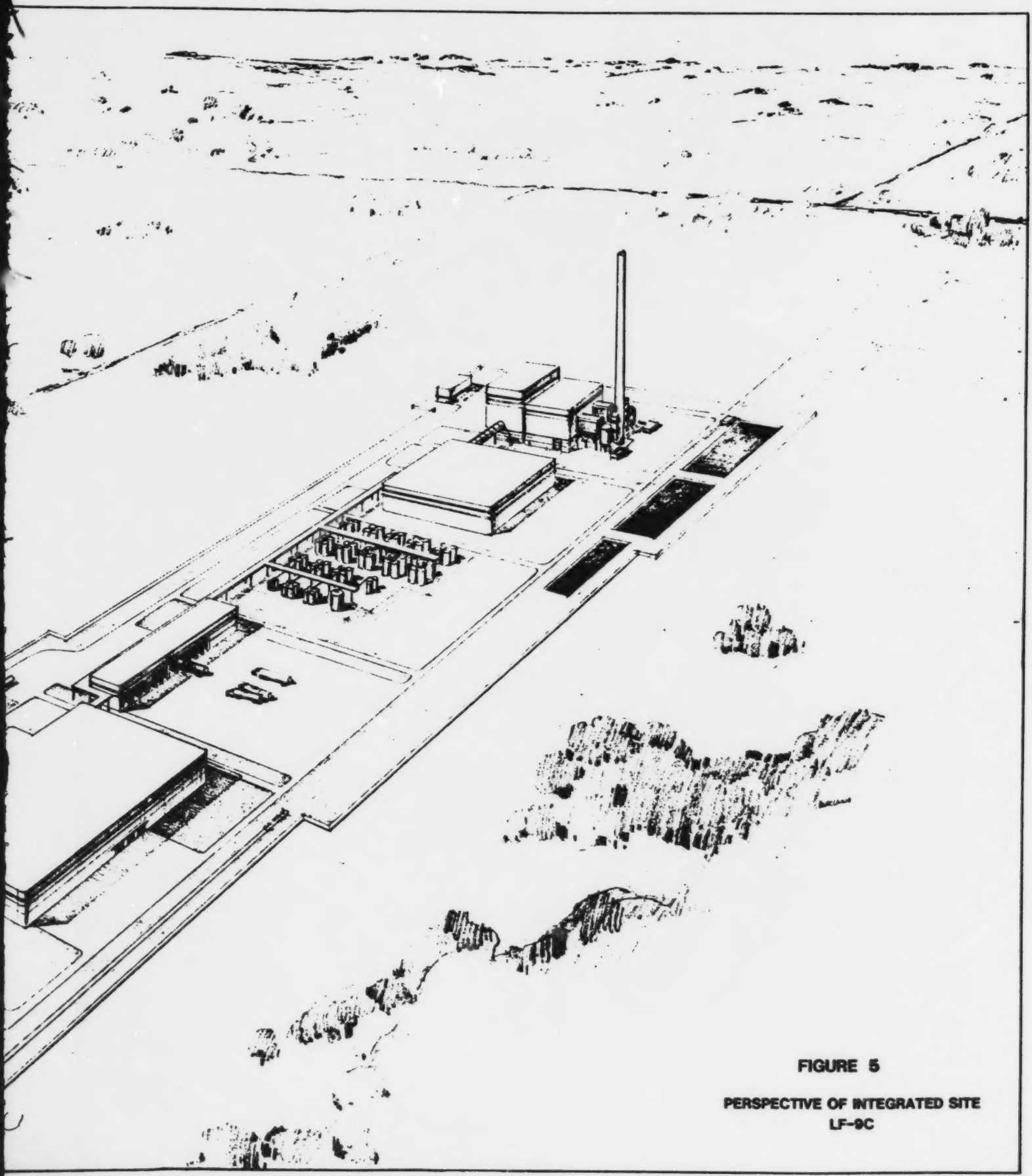


FIGURE 5

PERSPECTIVE OF INTEGRATED SITE
LF-9C

- the area occupied for the central operating area was 19.9 ha compared to 17.4 ha for the generic modular layout, which therefore resulted in a cost increase over other siting options.

3.4 EVALUATION OF ALTERNATIVES

As previously mentioned, many alternative configurations of site layout were examined in arriving at the generic modular layout and the alternative rectangular layout described in Section 3.3 and illustrated on Figures 2 and 4.

While the alternative layout was developed specifically for the preferred site at West Lincoln, it was recognized that this alternative offered a possible advantage over the generic modular layout used during Phase 4A for all other sites, in that the central operating area could be divided into two distinct areas, namely organic storage/treatment and inorganic storage/treatment. This had some merit from a design and operational viewpoint, in that it provided an additional degree of safety in physically separating two major process areas.

For this reason, additional studies were conducted to determine whether the alternative rectangular layout could be accommodated on all other siting options should this be preferred during site specific design work planned for Phase 4B of the Facilities Development Process. It was confirmed that the alternative rectangular layout could be accommodated on most siting options.

It was recognized that an opportunity would exist to refine the site layouts following selection of a preferred site. Both layouts were therefore considered equally acceptable for the purposes of Phase 4A.

The selection by OWMC of the site at West Lincoln in September 1985 initiated the site specific design activity, including refinement of the layout described in this Section.

3.5 DESIGN AND OPERATION

This section deals with the development of a site specific layout for West Lincoln, commencing with the alternative generic rectangular layout established in Phase 4A of the Facilities Development Process.

3.5.1 DESIGN

A review of the design work by Monenco Limited, OWMC and Hessische Industriemüll GmbH (HIM), resulted in several additional design criteria to those previously identified in Section 3.2 of this chapter. These further criteria were:

- Inorganic bulk waste unloading facilities should be located as close as practical to the waste storage tanks, to minimize the possibility of solids plugging the transfer pipes.

- Organic tank truck unloading area should similarly be located as close as practical to the incinerator tank farm, recognizing that some separation is required for safety considerations.

- Inorganic and organic drum storage and handling facilities should be separated, and located as close as practical to their respective process areas.

- The facility layout must accommodate a storage building (warehouse) to store either organic and/or inorganic waste pending more exact determination of an appropriate treatment and/or disposal method. This storage building to be located in the core zone of the central operating area.

OWMC's air dispersion consultant, Ontario Research Foundation, recommended that the stacks for the incineration plant (Ref: Monenco Limited[6]) and for the evaporator used for disposal of surplus effluent (Ref: Monenco Limited[7]), be separated by as great a distance as practical to avoid interference between the two stack plumes. As there was some

flexibility, it was agreed that the incineration plant stack be located as far away from Highway 20 as practical, hence the evaporator stack is located at the physical/chemical treatment plant at the north end of the central operating area. The acceptability of this orientation is to be confirmed by the impact assessment.

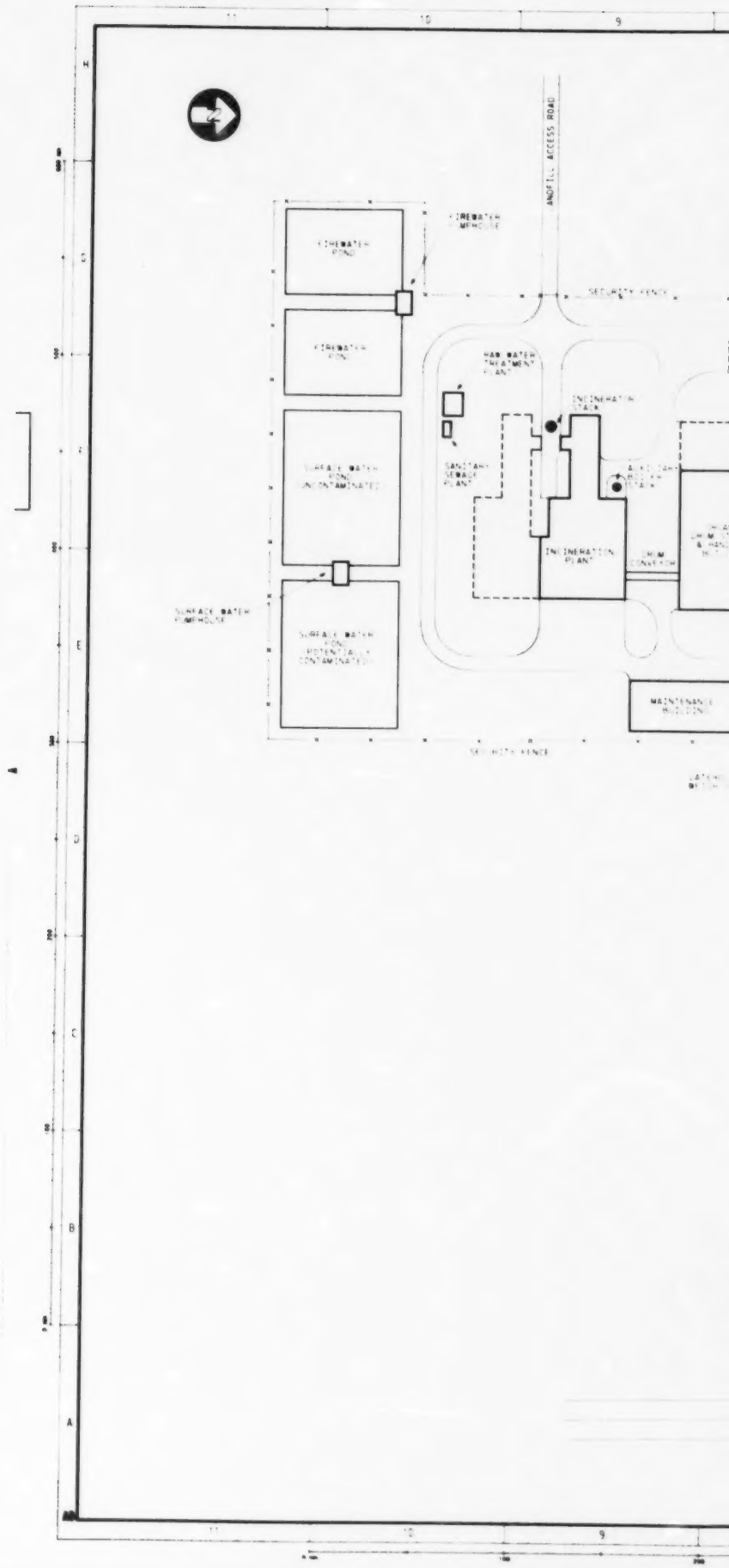
In addition, the design of various process areas had advanced further since the development of generic layouts in Phase 4A, and the layout at the West Lincoln site therefore was finalized using more definitive information on building and equipment sizes.

The criteria established for development of the plant layout, as detailed in Section 3.2 and earlier in this Section 3.5, determined the basic configuration of main process components, as illustrated on Figures 1 (Site Plan p. 4), 6 and 7. The consideration of traffic movement was a major factor in refining this plant layout and the direction of traffic is indicated on Figure 8 (p. 37).

The following points arose during the refinement of the central operating area layout.

- The division of plant components into organic at the south end and inorganic at the north end became even more distinct, given the additional design criteria which required separation of inorganic/organic bulk waste unloading areas and drum storage/handling.

- It became clear that an entrance at the middle of the Facility would be preferable as it would provide the simplest, most direct traffic movement. This, in turn inferred a main entrance off Schram Road, rather than Highway 20. Consideration was still given to providing access to the Facility from Highway 20 and although in some cases, traffic movement was acceptable, it was impossible to provide the administration building with visual access to the unloading areas and at the same time, have the unloading areas


LANDFILL ACCESS ROAD
SECURITY FENCE
INCINERATOR POND
INCINERATOR MANHOLE
SURFACE WATER POND (NONCONTAMINATED)
SURFACE WATER POND (POTENTIALLY CONTAMINATED)
SURFACE WATER MANHOLE
H&R WATER TREATMENT PLANT
INCINERATION STACK
SANITARY SEWAGE PLANT
INCINERATION PLANT
MAINTENANCE BUILDING
SECURITY FENCE

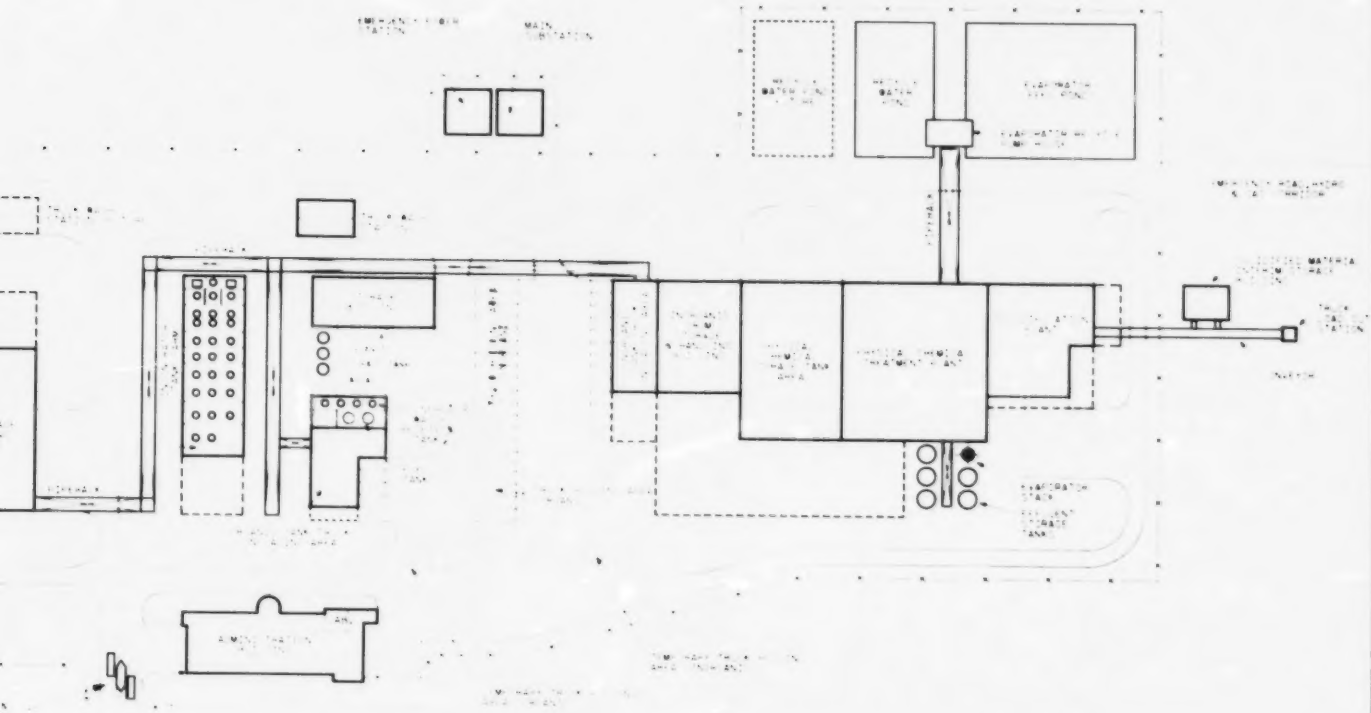


FIGURE 6

ARRANGEMENT OF CENTRAL OPERATING AREA

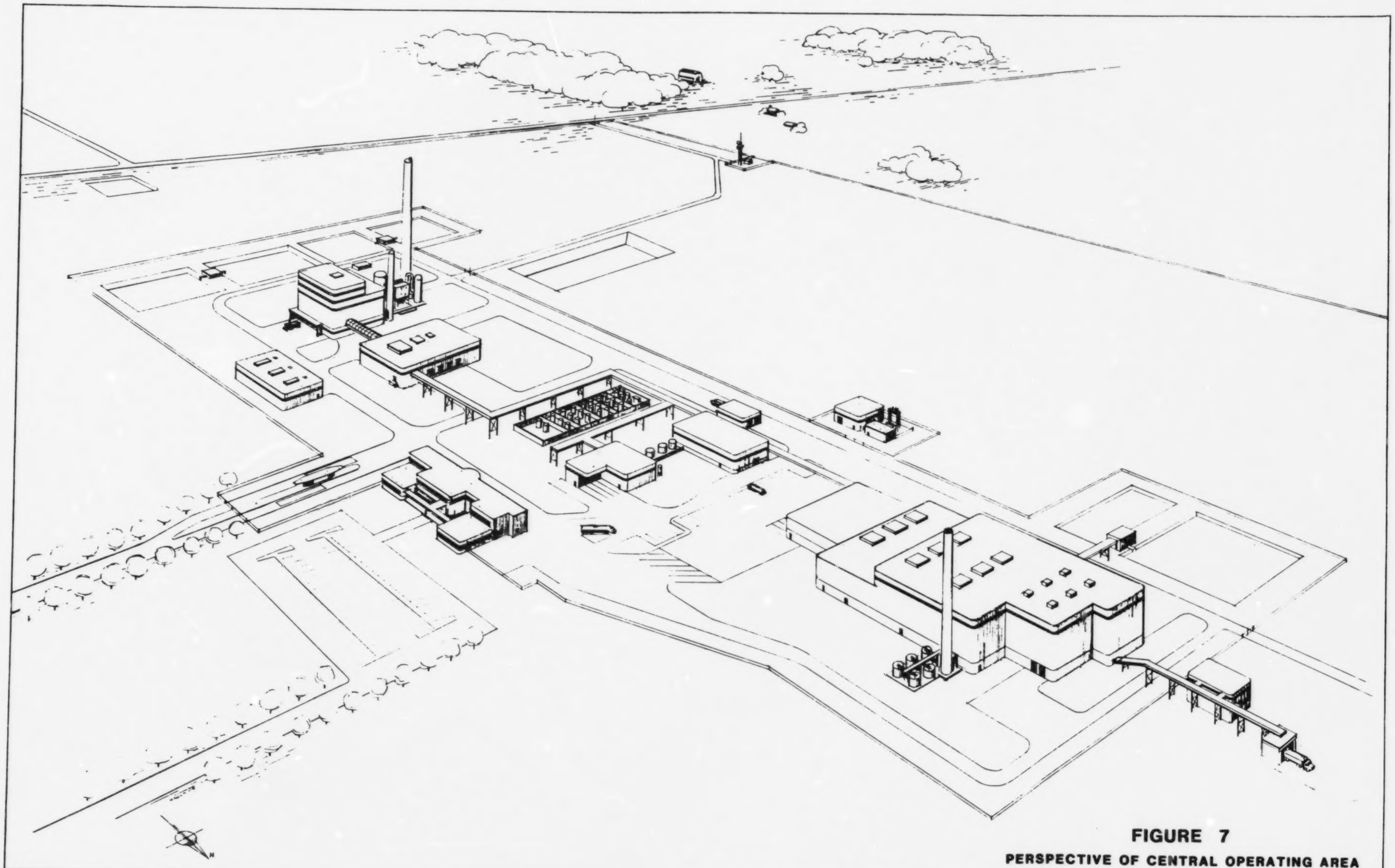


FIGURE 7

PERSPECTIVE OF CENTRAL OPERATING AREA

correctly located within their own facilities (organic or inorganic). The distance trucks would have to travel on site was also greater in most cases than with the main entrance off Schram Road. From these assessments, it became obvious, from the aspects of one-way traffic movement, distance to be traveled by trucks once on site and visual contact between the administration building and unloading, that the best location for the access road was just south of the unloading area as shown on Figure 8 (p. 37).

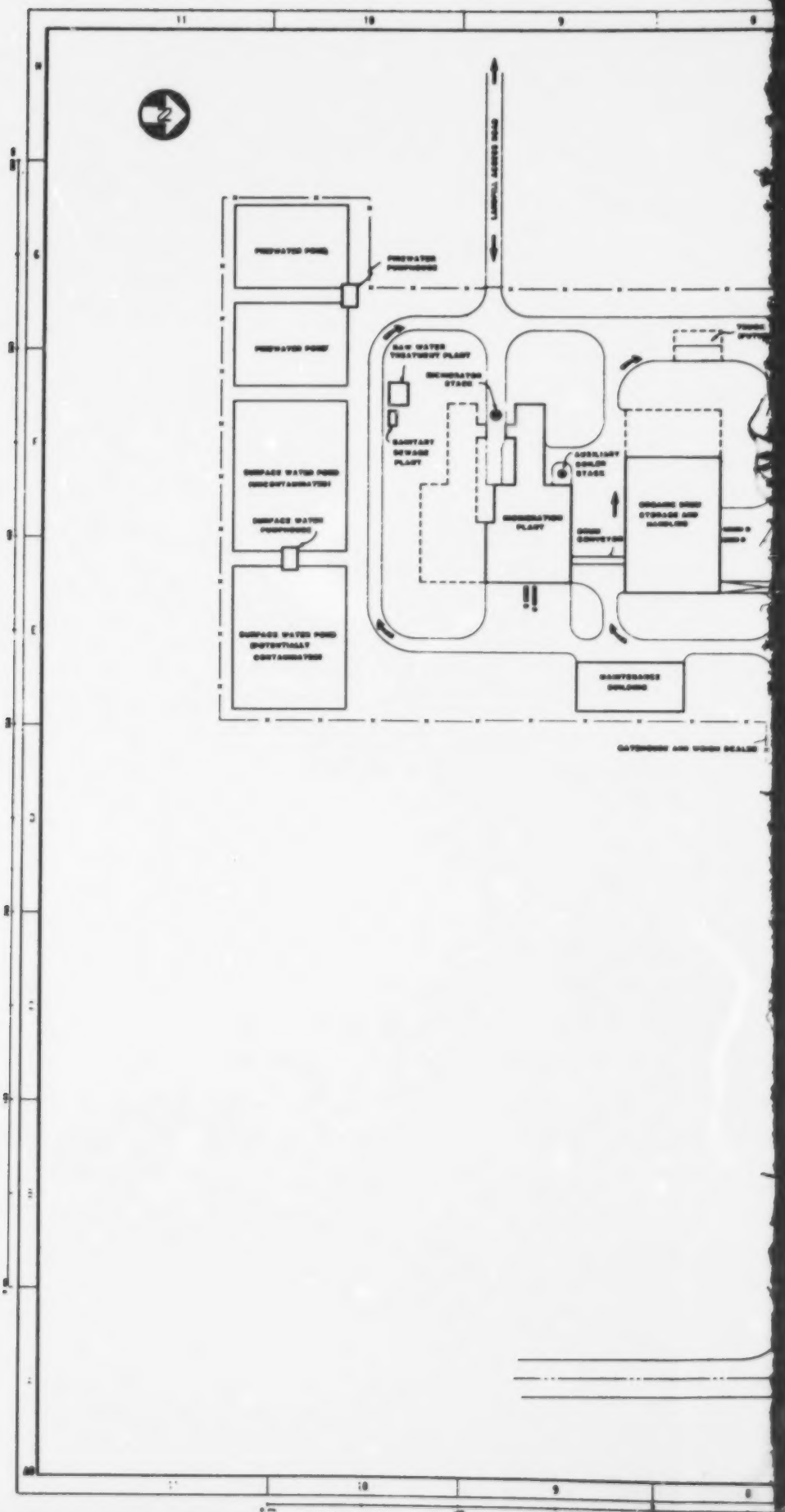
- The inorganic bulk waste unloading area, inorganic drum storage and handling area, physical/chemical storage tank area, physical/chemical treatment plant and solidification plant were all arranged adjacent to one another consistent with the design criteria previously described.

- An interim storage area for solidified material, pending transfer by truck to the engineered landfill, was located outside the central operating area but adjacent to the solidification plant.

- The surface water ponds are located in the southern part of the central operating area to take advantage of the natural fall in the ground towards the south.

- The fire pond also located in the southern part of the central operating area as the water is expected to be supplied from the south (the Welland River).

- The recycle water and evaporator feed ponds were located on the west side of the central operating area remote from the administration building and, at the same time, as close as practical to the physical/chemical area where the evaporator is located.


LANDFILL ACCESS ROAD
PREWATER POND
PREWATER POND
RAW WATER TREATMENT PLANT
INCINERATION STACK
SANITARY SEWAGE PLANT
AUXILIARY BOILER STACK
INCINERATION PLANT
ORGANIC WASTE STORAGE AND HANDLING
SURFACE WATER POND (NON-CONTAMINATED)
SURFACE WATER PUMPHOUSE
SURFACE WATER POND (POTENTIALLY CONTAMINATED)
MAINTENANCE BUILDING

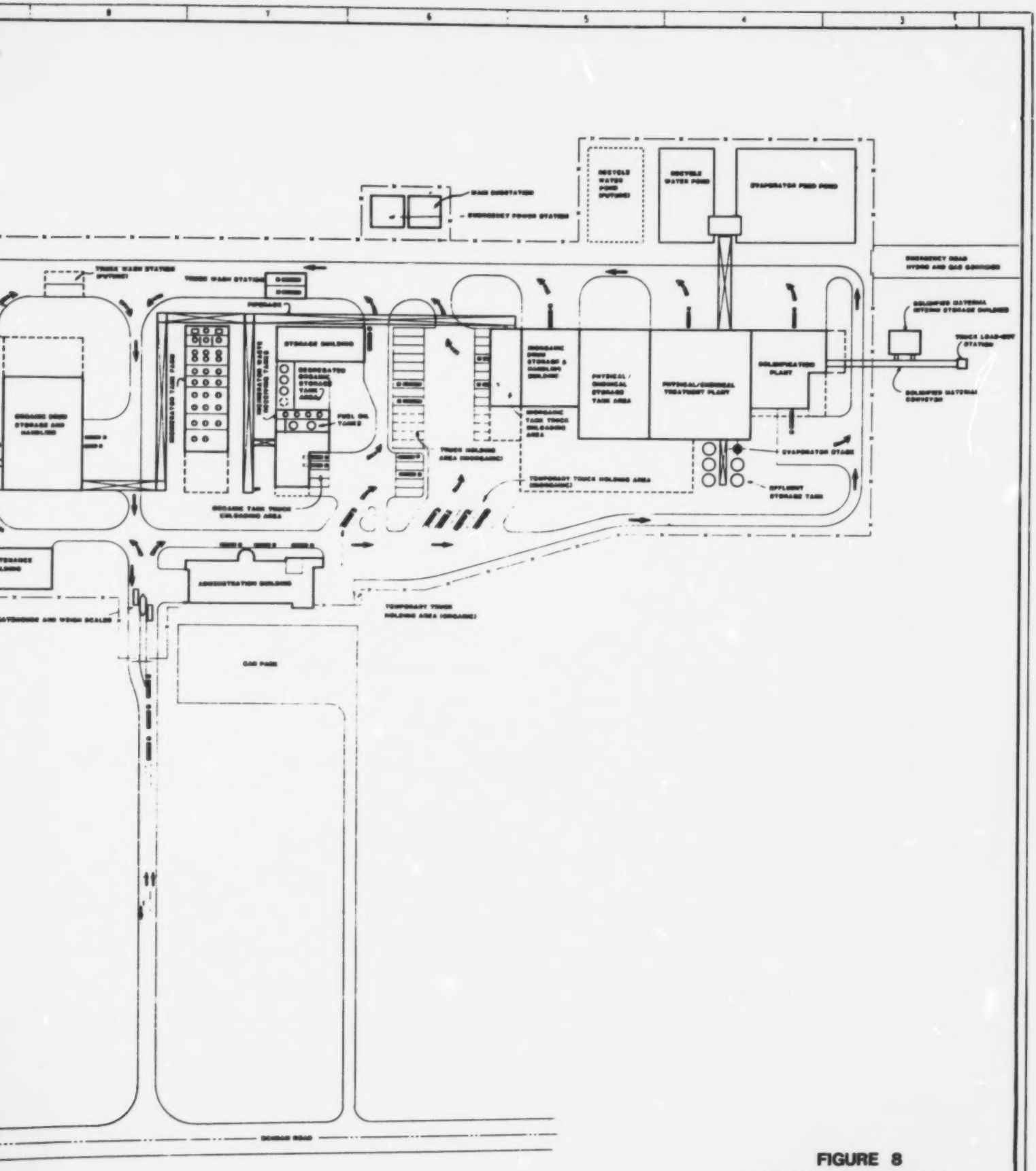


FIGURE 8
CENTRAL OPERATING AREA
TRAFFIC PATTERN

- The main electrical substation is located centrally on the west side of the central operating area since:
  - a location at the perimeter fence avoids transmission lines crossing the central operating area,
  - a location central to the central operating area is preferred for power distribution purposes,
  - this position is convenient to the transmission line bringing power from the north of the site.

- In evaluating the location of alternative emergency access it was decided that it should be independent and connect to a road other than Schram Road. Both Vaughan Road and Highway 20 were considered for this purpose.

- It was decided that, as electrical power and natural gas would come into the site due south from Highway 20 through a utility corridor in the landfill area, it would be prudent to avoid reducing the landfill area by widening that corridor to provide an emergency access road. During meetings the Smithville Fire Department recommended that the two emergency access routes to the site should be from different directions. It was then considered the second emergency road could be the same road used to transport excess clay from the landfill area. This road will be relocated from time to time as the active landfill area moves across the site.

- The resultant layout of the central operating area occupies approximately 20 ha of the 124 ha site as now confirmed by survey during Phase 4B.

3.5.2 OPERATION

The following operational description underlines the main features of the Facility layout.

All trucks delivering waste will enter the Facility via the main entrance where the gatehouse and weigh scales are located.

Waste will be delivered by one of three methods.

- o tank trailers up to 40 m^3 capacity carrying bulk organics or inorganics in pumpable liquid or sludge form.

- o truck trailers carrying up to 80 drums which could contain either organic and/or inorganic waste.

- o trucks of various types delivering bulk, non-pumpable solids.

Upon arrival a truck will stop at the gatehouse where its waybill will be checked against computer records and the truck weighed. The truck will then be directed to either an unloading destination or to a location close to the main laboratory for sampling as follows:

- o tank trailers carrying bulk waste liquids or sludges.

  After clearance from the gatehouse the truck will be directed to a location close to the North West corner of the administration building where a laboratory technician will take a sample of the delivered waste for analysis. Once the sample has been taken the truck will be directed to the temporary truck holding area to await results of the analysis.

  The laboratory technician, having confirmed the truck contents, will then advise the driver which truck holding area/unloading bay to proceed to for unloading. After unloading, the truck will continue in the prescribed direction either by-passing or going through the truck wash facility to the gatehouse, where it will again be weighed and cleared for exit.

  The procedure is similar for trucks containing organics or inorganics, the only difference being the location in the holding area to which they would be directed and the actual unloading station utilized.

- trucks delivering wastes in drums.

  Vehicles could deliver drums collected from a variety of generators and thereby have drums containing organic waste and drums containing inorganic waste. Drums will be unloaded at their applicable drum storage and handling building (organic or inorganic).

  Alternately, all drums may be unloaded at one drum storage and handling building to await sampling and testing to determine their correct destination.

  Having been unloaded, the truck will follow the one way route to the main gate where the vehicle will be weighed and given clearance to leave the site.

- trucks delivering bulk solids.

  On verification of its waybill the vehicle will be weighed, its contents visually inspected and if required, fingerprint samples taken for analysis.

  If the vehicle contains organics, the driver will be directed to the incinerator waste pits or to the solidification residues pit if it contains inorganics.

  After unloading, trucks will return to the gatehouse (via the truck wash if required) for weighing and clearance to exit the site.

The movement of waste materials through the treatment facilities is basically from the centre outwards. Inorganic materials will be unloaded at either the inorganic drum storage and handling building or the inorganic tank truck unloading area. From there the materials will move through the physical/chemical treatment plant and on to the solidification plant from where they will go to landfill. Dry non-pumpable inorganic wastes will be delivered to the solidification building.

With the exception of dry organic bulk waste, which will be delivered directly to the incinerator waste pits, organic wastes will be unloaded at either the organic drum storage and handling building or the organic tank truck unloading area and transferred to the incinerator tank farm and eventually to the incineration plant.

As far as traffic movement is concerned, the only vehicles that will be permitted within the central operating area under normal circumstances will be those delivering wastes and/or reagents, and their speed will be restricted to 8 km/h.

Trucks delivering anything other than wastes will drive to the respective receiving area along the one way traffic pattern. Vehicles such as police cars, ambulances and fire trucks will be summoned by plant personnel who will direct traffic flow on the site to enable emergency vehicles to take the most direct route to the problem area regardless of normal traffic direction.

CHAPTER 4
SAFETY AND SECURITY

4.1 INTRODUCTION

This chapter deals with three subjects directly related to safety and security at OWMC's proposed treatment Facility, specifically:

- o engineered containment systems designed to minimize the release of contaminants to groundwater systems,
- o fire protection features, and
- o plant security.

Each of the following subsections examines the purpose of the systems, alternatives considered, evaluation of alternatives, and the design and optimization of the preferred option.

4.2 ENGINEERED CONTAINMENT

4.2.1 PURPOSE

The purpose of engineered containment systems is to minimize, to the extent practical, opportunities for the release of contaminants from the central operating area to groundwater systems. This underlines OWMC's commitment to provide highly engineered systems in the central operating area of the Facility. No reductions in engineered systems have been made to take advantage of the natural containment provided by the West Lincoln site.

The design of engineered containment systems to minimize the opportunity for release of contaminants from the site via surface water systems, is addressed in Chapter 11 (p. 175), which deals with the design of storm water collection and discharge.

4.2.2 DESIGN CRITERIA

The criteria established for design of engineered containment systems are:

- the design shall include engineered features, wherever practical, to minimize the opportunity for contaminant pathways from the central operating area to the groundwater system, and

- components of the Facility employed to store pumpable liquid and sludge wastes must have two levels of engineered containment.

4.2.3 CONTAINMENT APPROACH

The approach that has been considered in the development of engineered containment systems for the central operating area is to provide engineered containment systems in selected areas most prone to contaminant release due to leaks and/or spills of waste.

This conventional, proven approach focuses on known areas of potential concern, and has the following specific advantages:

- Several levels of protection can be engineered for containment.

- Containment systems can be engineered from rugged, conventional construction materials such as steel and concrete, which are least prone to damage and general deterioration during the lifetime of the Facility.

- Specially designed systems can be developed to meet particular concerns as a means of most directly eliminating potential contaminant pathways to the ground water systems i.e. custom designed systems in specific areas.

- Containment systems of this type can generally be inspected, tested to assure continued integrity and readily repaired, if necessary.

- Local monitoring can be provided to identify a potential containment failure, so that remedial action can be instituted with minimal delay.

This approach of double containment in specific areas is considered more effective and practical than providing containment for the central operating area by placement of a synthetic liner or a concrete pad. The integrity of such a liner or concrete pad over the long term is suspect due to potential damage during construction, differential settlement arising from structural loads and leakage through joints and faults.

4.2.4 DESIGN AND OPERATION

This section addresses the design and operational considerations of incorporating engineered containment systems in the central operating area of OWMC's Facility.

Bulk Waste Unloading Areas

The design of bulk pumpable waste unloading areas is described in Chapter 5, and includes below ground receiving tanks for certain organic waste types, and for all inorganic wastes.

Design criteria established for pumpable wastes require a double engineered containment system, and this would therefore comprise a steel or fibreglass reinforced plastic receiving tank for organic and inorganic waste respectively, located in a concrete pit. The choice of material is based on a preliminary evaluation of materials of construction for the various components of the Facility. This arrangement not only provides secondary containment but also permits access around the receiving tank for inspection and/or repairs.

Below ground pits, which are located in the incineration plant and solidification plants for storing dry organic and inorganic materials respectively, normally do not require double containment systems. However,

concerns do exist, due to the high water table at the West Lincoln site. Groundwater may leak into the pits and this could provide a pathway for contaminants to be transported to the groundwater system, particularly if the ground water recedes as the water table drops. For this reason, suitably resistant liners inside concrete storage pits will be employed as a means of providing additional assurance against this occurrence.

Process Areas

The main process areas of OWMC's Facility will include process systems comprising tanks, pumps, pipework systems and special equipment which provide the first (primary) level of engineered containment of waste.

Secondary containment will be provided by the following engineered systems:

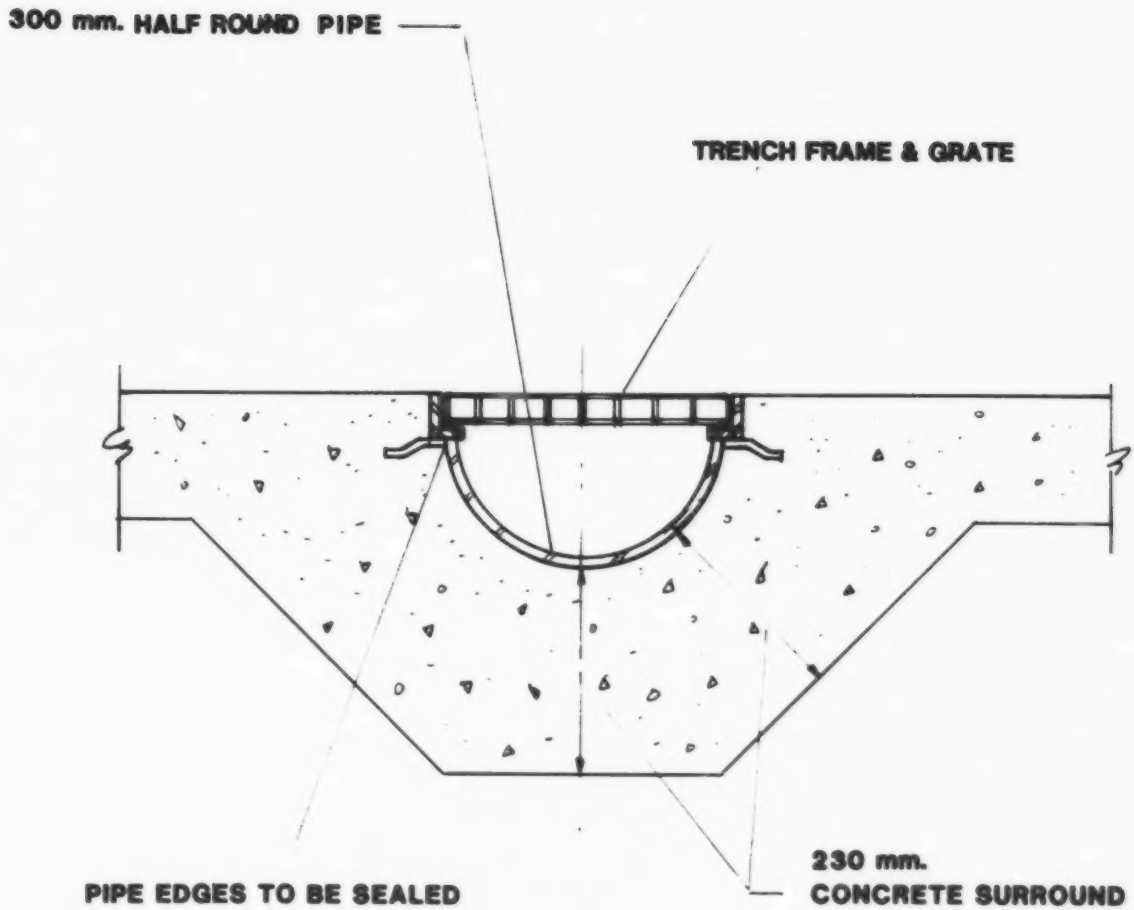
- Concrete and/or tiled floors surrounded by 150 mm high curbs around process equipment areas.

- Lined floor drains comprising steel or fibreglass reinforced plastic lined concrete floor channels depending on the type of wastes (organic or inorganic) to be encountered. See Figure 9 (p. 46).

- Drainage sumps comprising steel or fibreglass reinforced plastic receiving tanks located in concrete pits to facilitate inspection (Figure 10). Sump tanks will include sump pumps for transfer of collected waste or washwater to a waste storage tank for treatment. Leak detection devices will be included in the second (concrete) containment sump to alarm the occurrence of a leak.

- All floor areas will be sloped to floor drains leading to sumps.

- In the event of a sump pump failure floor drain sumps will overflow to the potentially contaminated stormwater system (Chapter 11) thereby providing a further level of containment assurance.



– FIBREGLASS REINFORCED PLASTIC PIPE USED IN INORGANIC AREAS

– STEEL PIPE USED IN ORGANIC AREAS

FIGURE 9

TYPICAL FLOOR DRAIN

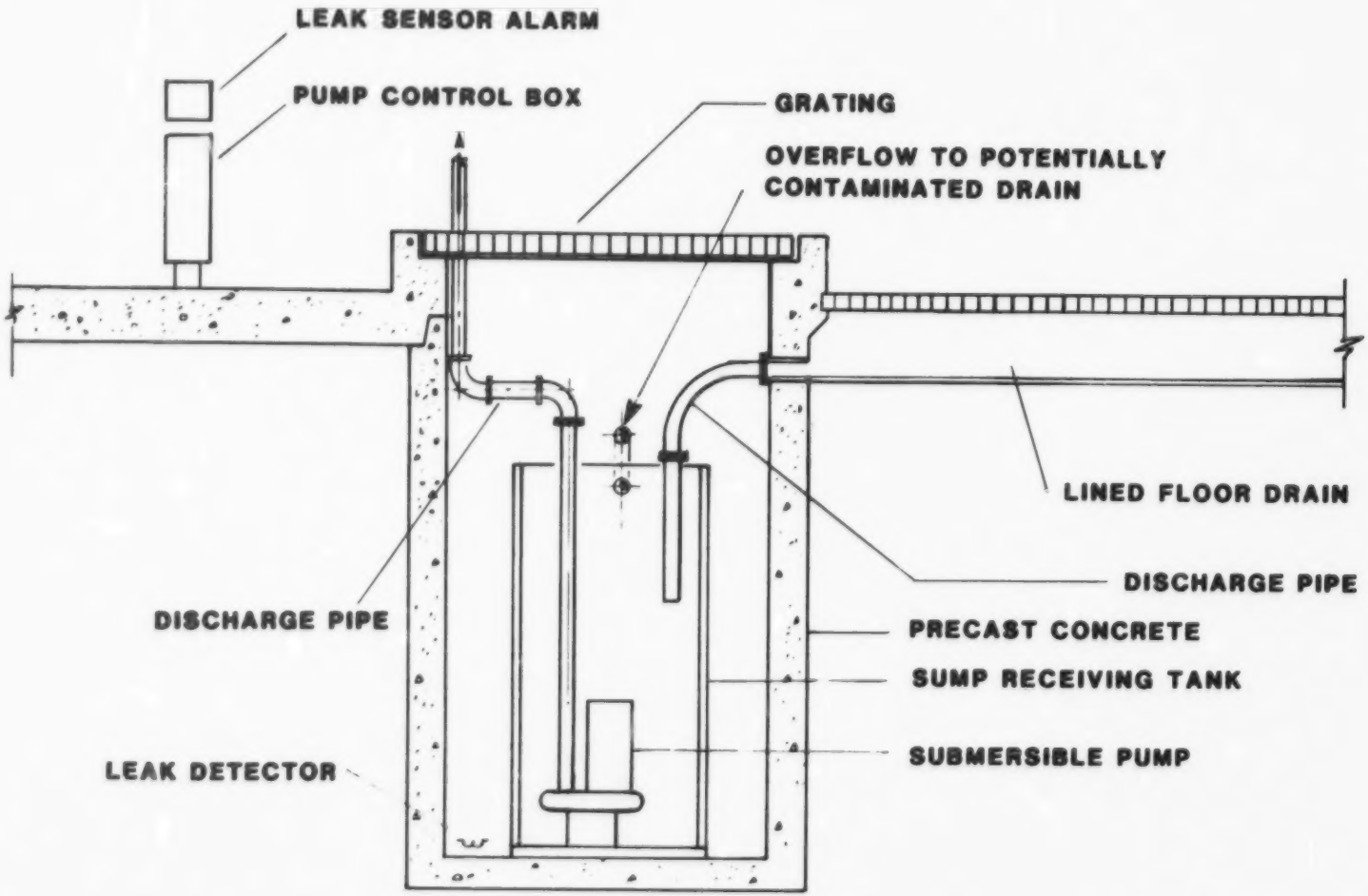


FIGURE 10

FLOOR DRAINAGE PUMP SUMP

Physical/Chemical Storage Tank Area

The storage tanks provide the first primary level of containment and concrete and/or tiled dykes provide the second level of containment. These facilities are further described in Chapter 6.

Outdoor Storage Tank Areas

The largest of these is the Incinerator tank farm. Spillage of waste due to overfilling a tank is unlikely, due to the extensive automatic shutoff and alarm features included in the design as well as overflow receiving tanks being provided for groups of storage tanks. Several engineered safeguards, including automatic shutoffs and alarms, would have to fail and/or be ignored by operating staff before waste could overflow into the secondary level of containment, which is in the form of a concrete dyked area surrounding groups of tanks (see also Chapter 6).

In addition to these precautions, codes and regulations also require that the tanks be contained within concrete dykes that, in the event of a tank rupture, will retain the contents within the dyked area.

As the tanks will be located outdoors, precipitation will also collect within the dyked areas. Under normal circumstances, this would be clean but even without any major spills or rupture, it could be contaminated by even the smallest leak from flanges or joints. For this reason, the liquid will be held within the dyked area until it is tested for contamination. If it is contaminated, it can be pumped back into a storage tank or to drain whereas, if clean, it can be sent to the potentially contaminated system described in Chapter 11.

Ponds

The surface water ponds used to collect stormwater, (Chapter 11), and the evaporator feed pond (Ref: Monenco Limited[7]), will be designed with double synthetic liners. A double liner has also been provided for the normally uncontaminated surface water pond as a safeguard should it become contaminated.

A permeable material will be placed between the two liners to facilitate monitoring and rapid detection of a leak in the first liner.

An additional aspect of containment relates to the necessity to provide measures which will ensure that trenches for sewers, watermains and other sub-surface utilities do not act as conduits for contaminant migration off-site. Counter measures will be developed in the detailed design phase of the project.

4.3 FIRE PROTECTION

4.3.1 PURPOSE

The purpose of fire protection systems is to ensure that the Facility is equipped with the necessary capability to minimize the consequences of fire, that could result in temporary loss of treatment capability, gaseous emissions and property loss.

Fire protection capability is represented primarily by the installation of systems and equipment for fire fighting purposes, but equally important are passive features of the fire protection system including:

- proper layout of the Facility with adequate building spacings and good road access for emergency vehicles (Chapter 3),
- design features such as explosion venting (Chapter 12), selection of materials of construction, and
- operator training, safety procedures, and emergency response plans (Ref: Monenco Limited[5])

4.3.2 DESIGN CRITERIA

The following criteria have been established for the design of fire protection systems at OWMC's Facility:

- The variations in the nature of wastes will be taken into account.

- Due consideration will be given to operator, facility staff and public safety.

- Fire protection systems will be selected based on standard industry practice in conjunction with the recommendations of OWMC's loss control consultant.

- The following codes, standards and guidelines will serve as reference for the design development of the fire protection system:

  - National Fire Codes and Standards of the National Fire Protection Association (NFPA);
  - Factory Mutual Standards (FM);
  - Canadian Industrial Risk Insurers Guidelines (CIRI);
  - Insurers Advisory Organization Guideline (IAO);
  - Ontario Fire Code, including Part 4, Section 4.3 (Proposed Draft);

- Proposed designs where applicable will be reviewed with the local Fire Marshal.

4.3.3 ALTERNATIVES CONSIDERED

While many aspects of design for the fire protection systems have been selected based on the requirements of relevant codes, standards and guidelines, experience on similar industrial facilities, and recommendations provided by OWMC's technology consultants and loss control consultants, the design development included consideration of various alternatives with regard for the following:

- Extent of reliance on area fire departments.
- Water supply for fire fighting.
- Type of drivers for firewater pumps.
- Fire fighting agents.
- Need for on-site fire truck/emergency equipment vehicle.

4.3.4 EVALUATION OF ALTERNATIVES

Extent of Reliance on Area Fire Departments

The proposed location for the Facility falls within the jurisdiction of the Smithville Fire Department. Preliminary joint discussions with this Department have provided the following information:

- Smithville fire station is approximately 16 km from the site and, as all their firemen are volunteers, response time could be about 15 minutes;

- A number of Facility staff will receive fire fighting training which will permit them to deal with minor outbreaks and take steps to contain a larger event until the fire departments arrive.

- It will be the responsibility of the Facility operating staff to identify to the fire department(s) what materials are involved.

It was determined that OWMC's Facility will be designed with a comprehensive on-site fire protection system to minimize the undesirable consequences of time delays in awaiting a response from Smithville Fire Department. This best satisfies OWMC's criteria regarding performance, safety, flexibility, reliability and operations.

Industry practice indicates that OWMC's Facility should incorporate a high degree of fixed systems. The fire protection system, therefore, will include a divided fire water pont, multiple fire water pumps, a valved underground firewater ring main, fire hydrants, monitors, sprinklers and foam systems.

The Facility operating staff will be trained in the use of these systems.

Water Supply for Fire Fighting

Three alternative areas of providing water for fire fighting purposes were examined.

- o Direct supply from municipal fire mains.
- o Direct supply from a natural water body such as the Welland River.
- o Indirect supply from one of the above via an onsite water body (eg. fire pond)

In the case of the site there are no municipal water mains in the vicinity, and the alternatives available for consideration were directly from the Welland River or via an on-site firewater pond.

An on-site firewater pond was selected since:

- o the firewater pumphouse can be located near the firewater pond and within the Facility confines, hence maximizing system reliability and minimizing delays should problems ever be encountered with the water supply system,

- o the need to run duplicate fire mains, for backup purposes, a distance of approximately 2 km to the Welland River is eliminated, along with environmental impacts of installing additional off-site facilities, and

- o superior water quality with less suspended solids can be assured from the firewater pond, due to settlement in the pond resulting in fewer potential operating problems with fire mains and sprinklers, thereby maximizing system reliability.

Overall it was evident that this alternative, involving the supply of water from the Welland River via an on-site firewater pond, best achieved OWMC's goals of minimizing risk to health and the environment, by providing the most reliable source of firewater to the Facility.

Type of Drivers for Fire Pumps

Alternative types of drivers for firewater pumps are as follows:

- o diesel engine,
- o gasoline engine, or
- o electric motor.

The prime criterion in the selection of firepump driver type is reliability, and the superior reliability of a system comprising diesel engine drives is evidenced by the following, in accordance with recognized industry practice.

- o Diesel engine drives are self contained units independent of an outside source of energy which could be interrupted during fire fighting demand as can be the case with electric motor driven units.

- o They provide superior starting reliability compared to gasoline engines.

In instances of multiple firewater pump installations, it is accepted practice to include the installation of a back-up unit with an electric motor drive, and this approach has been adopted for OWMC's Facility.

Fire Fighting Agents

The most commonly used and generally most effective agent for fire fighting purposes is water. There are, however, specific types of fires where the use of alternative agents has been proven to be more effective in their performance. Examples of these, and the agent utilized, are as follows:

- o Fires occurring with organic liquid are more readily controlled by foams.

- o A specialized fire fighting agent such as Halon is used for Control Rooms and similar installations, where the use of water is not recommended.

- o Fires in electrical installations are, in some cases, controlled by carbon dioxide (a non-conducting gas) to eliminate the risk to human health of electrical conductance which would occur with the use of water.

The wide range of substances which will be present within the Facility required detailed consideration of each specific area of the Facility on an individual basis. The result is the selection of specific fire fighting agents which have been proved from experience to be the most appropriate to the application.

Need for Fire Trucks/Emergency Vehicle

Consideration will be given to equipping the Facility with its own pumper fire truck. The need will be evaluated taking into account the level of protection given by the fixed systems and the provision to be made in the Emergency Response Plan presently being formulated by OWMC.

It is likely, however, that an on-site emergency vehicle will be provided for transporting fire protection equipment such as hoses, foam concentrate, fire axes, breathing apparatus and dry chemical extinguishers.

The need for such a vehicle will be reviewed during the detailed design in conjunction with OWMC's loss control consultant and the local Fire Marshal.

4.3.5 DESIGN AND OPERATION

This section describes the design and operation of fire protection systems at OWMC's Facility.

The proposed fire protection system will incorporate fixed protection utilizing various fire fighting mediums. The major fire fighting medium for the Facility is water, this is used not only in direct application to fires but also as the major constituent of foam for the foam system.

The firewater system will consist of a firewater pond, with two equal sized sections, which stores water and feeds the fire pumphouse. This pumphouse will contain firewater pumps which will supply water to an underground ring main around the central operating area so that water can be supplied to any specific location from two directions. The ring main will be valved to allow maintenance work to be performed without interrupting the fire protection to any specific location.

The ring main will supply fire hydrants to enable outdoor fire fighting using hoses connected to the hydrants and will also supply fixed fire protection systems located within Facility buildings. These fixed systems include standpipes and hose cabinets, sprinkler systems and deluge systems.

Additionally, the ring main will supply water to the foam system which will proportion the required amount of foam concentrate, add the concentrate to the fire water and discharge fire fighting foam, via a separate foam main, to the foam fire fighting systems. The detailed design phase of the project will determine whether a central foam system, or a number of local foam systems will be installed within the Facility.

Halon gas fire protection will be utilized in process control rooms and in the instrument rooms of the laboratories. The control rooms will be equipped with central halon systems consisting of Halon charged gas cylinders supplying fixed discharge nozzles through a permanently installed distribution piping system. The Laboratory instrument rooms will be equipped with portable, wall mounted Halon gas extinguishers.

Portable fire extinguishers will also be located throughout the Facility.

All automatic fire protection systems will be controlled by fire detectors, of a type appropriate to the application, which will automatically initiate the operation of the specific system and alarm the occurrence. Continuous automatic monitoring of all systems will also be provided.

Table 2 provides a summary of the various types of fire protection provided in different areas of the Facility.

System Sizing

Sizing of major components of the firewater systems is based on accepted practice and has been reviewed in conjunction with OWMC's loss control consultant.

The firewater pond will provide a total storage volume of 7575 m^3 exclusive of ice cover and will be sub-divided into two equal sized compartments.

The volume of each compartment will support fire fighting for a duration of 4 hours.

There will be three firewater pumps, each sized to supply 158 L/s. Two of the units will be diesel engine driven and the third unit will be electric motor driven. Any two of these units will be capable of supplying the maximum anticipated fire flow of 220 L/s. A small firewater jockey pump will be provided to maintain the pressure in the firemains system.

Fire hydrants and monitors will be sized for flows of 63 L/s and 31.5 L/s respectively.

Expansion of the firewater system will be accommodated by the provision of blanked connections on the fire mains to allow the installation of additional sections of fire mains adjacent to expanded or added buildings, during any future Facility expansion. Such future expansions will not require additional design capacity in the fire protection system as the fire protection system is designed to protect against fire in one area of the Facility only, at any given time.

TABLE 2 - FIRE PROTECTION SYSTEM EQUIPMENT

AREA	FIRE PROTECTION SYSTEM
Administration Building	External hydrants, sprinklers, standpipe and hose cabinets, fixed Halon in Computer Room, portable Halon in Instrument Room of the Laboratory, standpipe and hose cabinets in balance of Laboratory.
Maintenance Building	External hydrants, sprinklers
Gatehouse & Weigh Scales	External hydrants
Solidification Plant	External hydrants, standpipe & hose cabinets
Physical/Chemical Treatment Plant	External hydrants, sprinklers, Halon in control room, portable Halon in Instrument Room of the Laboratory, standpipe and hose cabinets in balance of Laboratory
Physical/Chemical Storage Tank Area	External hydrants, sprinklers, foam deluge for organic storage area
Inorganic Drum Storage and Handling Building	External hydrants, sprinklers, portable Halon for Control Room
Inorganic Tank Truck Unloading Area	External hydrants, water deluge
Incineration Plant	External hydrants, standpipe & hose cabinets, water deluge for bunkers and kiln feed chutes, Halon for Control Centre
Organic Drum Storage and Handling Building	External hydrants, foam sprinklers,portable Halon for Control Room
Incinerator Tank Farm	External monitor hydrants

TABLE 2 - FIRE PROTECTION SYSTEM EQUIPMENT (Cont'd)

AREA	FIRE PROTECTION SYSTEM
Organic Tank Truck Unloading Area	External hydrants, foam deluge
Incinerator Waste Receiving Tanks	External monitor hydrants, foam
Segregated Organic Storage Tank Area	External hydrants, foam deluge water spray
Storage Building	External hydrants, foam injected sprinklers water sprinklers in foam house
Main Substation	Firewalls separating Main Transformers from each other and from Emergency Power Station
Emergency Power Station	External hydrants
Surface Water Pumphouse	External hydrants
Sanitary Sewage Plant	External hydrants
Raw Water Treatment Plant	External hydrants, standpipe and hose cabinets
Firewater Pumphouse	External hydrants, sprinklers
Solidified Material Interim Storage Building	External hydrants
Solidified Material Conveyor	External hydrants
Drum Conveyor	Foam deluge

TABLE 2 - FIRE PROTECTION SYSTEM EQUIPMENT (Cont'd)

AREA	FIRE PROTECTION SYSTEM
Pipe Rack	External hydrants and monitors
Temporary Truck Holding Area (organic)	External hydrants
Truck Holding Area (organic)	External hydrants
Temporary Truck Holding Area (inorganic)	External hydrants
Truck Holding Area (inorganic)	External hydrants
Car Park	External hydrants
Truck Load Out Station	External hydrants
Truck Wash Station	External hydrants, sprinklers
Evaporator/Recycle Pump House	External hydrants
Fuel Oil Tanks	External Monitor hydrants plus foam
Effluent Storage Tanks	External hydrants

Note: In addition to the above, the numbers, types and locations of portable fire extinguishers will be determined during the detail design phase of the project.

Passive Fire Protection

The following passive fire protection features have been incorporated into the overall Facility design. Such features underline the consideration which has been given to ensuring that OWMC's Treatment Facility is designed to the highest standards with regard to the minimization of risk to human health, the environment and cost resulting from fire.

- Appropriate distances between process areas within the Central Operating Area, to ensure adequate separation between high hazard areas and locations where people are concentrated (eg. between the administration building and the incinerator tank farm).

- Adequate spacing between process areas to prevent a possible domino effect leading to increased loss and to prevent major damage to adjacent units from hazards such as fire and explosions.

- Adequate access for fire fighting purposes with at least two access routes from different directions.

- The use of appropriate materials and types of construction for buildings and structures within the Facility to provide the necessary fire resistance ratings specific to the application.
- The provision of fire separation walls between adjacent areas within areas to ensure appropriate protection to each area.

- The utilization of explosion venting panels in building construction, where required.

- The design of electrical distribution systems to the appropriate classifications for the service.

- The design of appropriate ventilation and inert gas blanketting systems to reduce hazard potential.

4.4 PLANT SECURITY

4.4.1 PURPOSE

The purpose of the security system is to minimize risk to human health, the environment, and Ontario's investment from undesirable consequences of unauthorized access to OWMC's Facility.

4.4.2 DESIGN CRITERIA

The criteria established for design of the plant security systems require that:

- o controlled access is to be provided to the site,
- o waste consignments, reagent deliveries and miscellaneous supplies shall be admitted to the Facility in a controlled manner,
- o visitors to the site must be checked in and out, and
- o critical parts of the Facility shall be provided with secondary levels of security to protect against damage and loss.

4.4.3 ALTERNATIVES CONSIDERED

The alternatives considered for plant security focused on the level of security to be provided at OWMC's Facility. Two alternatives considered were:

- o a level of security appropriate to an industrial type facility, such as chemical plants and oil refineries, or
- o a high level of security such as installed at certain military installations and penal institutions.

4.4.4 EVALUATION AND SELECTION

Conventional levels of security used at industrial facilities involve totally fenced sites, controlled access points, visitor passes and personnel identification tags.

High level security systems involve multi-fence arrangements patrolled on a continuous basis, with multi-stage controls for access of personnel and deliveries to the Facility.

Since this is a typical industrial plant type application a conventional level of security was selected taking into consideration that:

- the main gate house will be staffed during waste receiving hours. Outside these hours, the gates will be closed and the security personnel will monitor movements in and out of the Facility.
- high level security systems, with measures to prevent sabotage are costly and give only marginal benefits over conventional systems,
- this can be arranged to provide a satisfactory level of security to prevent unauthorized entry to the Facility,
- a high level of control can be provided over the delivery of waste and supplies to the Facility,
- a high level of control can be exercised over the admission of employees and visitors,
- additional levels of security can be maintained in areas of the Facility to protect human health, the environment and Ontario's investment.

4.4.5 DESIGN AND OPERATION

This section addresses the design and operational considerations of security systems at OWMC's Facility.

The initial barrier to unauthorized entry to the Facility will be a 3 metre high chain link fence, with extension arms carrying three strands of barbed wire, surrounding the entire perimeter of the site. The main opening in this fence will be for the main plant access road, which will have a gatehouse with security staff present during normal waste receiving hours. Outside these hours, the gates will be closed and security personnel will either be on routine patrols or stationed at a post by the employee entrance to the administration building to monitor movement of employees into and out of the Facility. The emergency access road will be unmanned but will have a locked gate and the landfill access road will be

manned by security staff during operating hours, outside of which it will be closed with a locked gate.

The site perimeter fence will be regularly inspected by security personnel.

Entry to the Central Operating Area, which will be separately fenced, will include two main control points, those being the main gate for vehicular traffic cleared for entry and the administration building for pedestrian traffic including employee's and visitors. Additional controlled access points will be included indirectly via the landfill area and from the utility and emergency road corridor.

All visitors, materials and vehicles authorized to enter will be checked in and out, as well as being accompanied by an OWMC employee where applicable. Access to the plant areas, control rooms and critical documentation systems will be restricted to authorized personnel only.

Visitors will be required to display identification, wear appropriate safety clothing where required, and be accompanied by an OWMC employee. Check-in and check-out procedures for all visitors and employees will be enforced, for both security reasons and safety purposes.

Trucks carrying wastes will be admitted generally only on the basis of prior notification and approval. Their contents will be checked against a pre- authorization sample and, after unloading, they will be inspected and weighed prior to leaving the Facility. Delivery of chemicals and reagents will be similarly controlled. Vehicles of contractors carrying out routine maintenance will require clearance on entry and exit. Private cars will not be admitted at any time. Once within the Facility, vehicles will be parked in authorized locations and left unlocked with the keys in the ignition.

Physical access to the incineration plant and physical/chemical treatment plant control rooms, as well as the Data Management System will be restricted to authorized personnel only. The main substation and the

emergency power station will be similarly restricted and, in addition, will be located at a distance from the site perimeter fence and surrounded by its own security fence with padlocked gates. Electrical switchgear and distribution equipment will be housed within the substation building and high voltage/warning signs will be conspicuously displayed.

In respect to the Data Management System, user access will be by access code, which will be controlled to prevent unauthorized data entry and retrieval. Regular archiving will be carried out to preserve historical data, both for the Data Management System and process control systems. As an added security measure, pertinent records of waste data, treatment procedures and monitoring will be duplicated for storage in an off-site location.

CHAPTER 5
BULK WASTE UNLOADING AND TRUCK WASH

5.1 INTRODUCTION

This chapter addresses the unloading of bulk waste shipments at OWMC's Facility, and the provisions included for washing of vehicles after unloading and prior to their departure from the Facility.

5.2 BULK WASTE UNLOADING

5.2.1 PURPOSE

OWMC's Facility will provide for unloading and transfer to storage of various types of wastes. The purpose of bulk waste unloading facilities addressed in this Chapter is to safely and efficiently unload and transfer to storage the following types of waste:

- o bulk pumpable liquids and/or sludges, in road tankers,
- o bulk pumpable liquids and sludges containing gross solids, in special road tankers or containers, and
- o bulk non-pumpable wastes, in dump trucks, providing the waste can be rendered pumpable by liquid addition and recirculation at the unloading station.

The unloading of the following waste types is covered in other reports or other sections of this report as identified below:

- Wet or dry inorganic solids will be normally unloaded at the solidification plant where inground pits and hoppers are provided to store these ready for processing. (Ref: Monenco Limited[8]) It is also possible to unload these solids into the inorganic unloading tanks if treatment in the Physical/Chemical plant is needed.

- Dry organic solids will be unloaded at the incineration plant where inground pits are provided to store these ready for incineration. (Ref: Monenco Limited[6])

- All waste delivered in drums will be unloaded and processed at the organic and inorganic drum storage and handling buildings described in Chapter 7 of this report.

- Selected liquid organic wastes designated as segregated will be unloaded by pumps directly into storage tanks in the designated area of the incinerator tank farm, to minimize the potential hazards of transferring toxic or obnoxious wastes, as described in Chapter 6 of this report.

- Sometimes liquid organic wastes designated as segregated will be unloaded directly from special containers to the incinerator process under nitrogen pressure, again to minimize the potential hazards of transferring toxic or obnoxious wastes. (Ref: Monenco Limited[6])

5.2.2 DESIGN CRITERIA

The criteria established for design of bulk waste unloading facilities stipulated that the design should:

- be sized to accommodate 150 000 t/a of waste delivered entirely as bulk pumpable waste, 5 days/week during the day,

- accommodate waste deliveries by road tankers, special road tankers or containers, and dump trucks,

- o accommodate tank trailers up to 40 m^3 capacity,
- o provide sufficient flexibility to handle significant variations in the quantity of any specific type of waste,
- o provide sufficient number of the unloading stations having equipment to remove gross solids from the waste,
- o provide pumping capability for vehicles that are not equipped with pumps or have pumps of insufficient capacity,
- o provide a capability to re-slurry selected non-pumpable wastes by liquid addition and recirculation, and
- o include facilities to rinse out any sludge or sediment from the tanker after unloading.

Design features will be included to ensure protection of plant operators and the environment during unloading operations, that will:

- o contain any leaks or spills during unloading,
- o control flammable vapours to minimize risk of fires/explosions, and
- o control toxic vapours to minimize environmental and health hazards.

5.2.3 ALTERNATIVES CONSIDERED

Several alternatives were considered in arriving at the proposed design for the bulk waste unloading facilities. These were as follows:

- o Unloading of vehicles by:
  - pumping,
  - gravity flow (dumping), or
  - pressurizing the tanker using a medium such as nitrogen.
- o Arranging the facilities to accommodate vehicles:
  - reversing into unloading stations, or
  - driving through unloading stations.

5.2.4 EVALUATION OF ALTERNATIVES

Consideration of vehicle unloading by pumping, gravity flow, or vehicle pressurization identified the following:

- o Vehicle unloading by pumping:
  - enables direct connection to receiving tanks thereby minimizing emissions of volatile gases where these are of concern to the environment,
  - provides flexibility in using vehicle mounted pumps or permanent pumps provided by the Facility, and
  - can be arranged in drive-through or reverse-in type unloading stations.

- o Vehicle unloading by gravity:
  - requires the vehicle to be located physically at a higher elevation than the unloading tanks.
  - is preferred to pumping where gross solids may be present in the waste since these would damage or block pumps and piping systems,
  - is also preferred where thick sludges require pretreatment by dilution with other liquids in unloading tanks, prior to pumping to storage tanks,
  - provides greater opportunity for fugitive emissions to the environment at the unloading tank, and
  - can accommodate drive-through unloading stations but is most amenable to reverse-in type unloading stations as further addressed later in this section.

- o Pressurization of tankers as a means of unloading:
  - is restricted to vehicles designed to withstand the unloading pressure, and as such is limited in its application,
  - would necessitate the waste receiving tanks being similarly designed to withstand the unloading pressure,
  - potentially increases the risk of waste spills during unloading, since a larger part of the waste containment system is under pressure,

- enables direct connection to receiving tanks, thereby minimizing fugitive emissions, and
- can be arranged in drive-through or reverse-in type unloading stations.

Overall, it was considered that OWMC's requirements could best be satisfied by facilities having a combination of pumped and gravity unloading provisions. This ensures that:

- o wastes can be unloaded safely and efficiently,
- o fugitive emissions can be minimized by using direct connected pumped unloading wherever feasible,
- o flexibility is provided to utilize both vehicle mounted or permanently installed unloading pumps, although the latter are preferred since the quality of maintenance of these is under the control of OWMC,
- o flexibility is provided to handle a range of liquids and pumpable sludges containing gross solids,
- o provision is included for pretreating thick sludges in the receiving tanks, and
- o both drive-through and reverse-in type unloading stations can be accommodated.

No additional advantages would be obtained from using pressurized unloading and the potential risks to personnel and the environment could be higher with such an arrangement.

The following three arrangements of unloading facilities were considered, including both drive-through and reverse-in configurations, as

illustrated on Figure 11. While this evaluation focuses on the unloading tanks, all alternatives also have the capability for pumped unloading via direct coupling to receiving and/or storage tanks.

Alternative 1

Vehicles unloading at an elevated level into tanks located at ground level, with the vehicles driving through the unloading station, or alternatively reversing to the unloading station.

Alternative 2

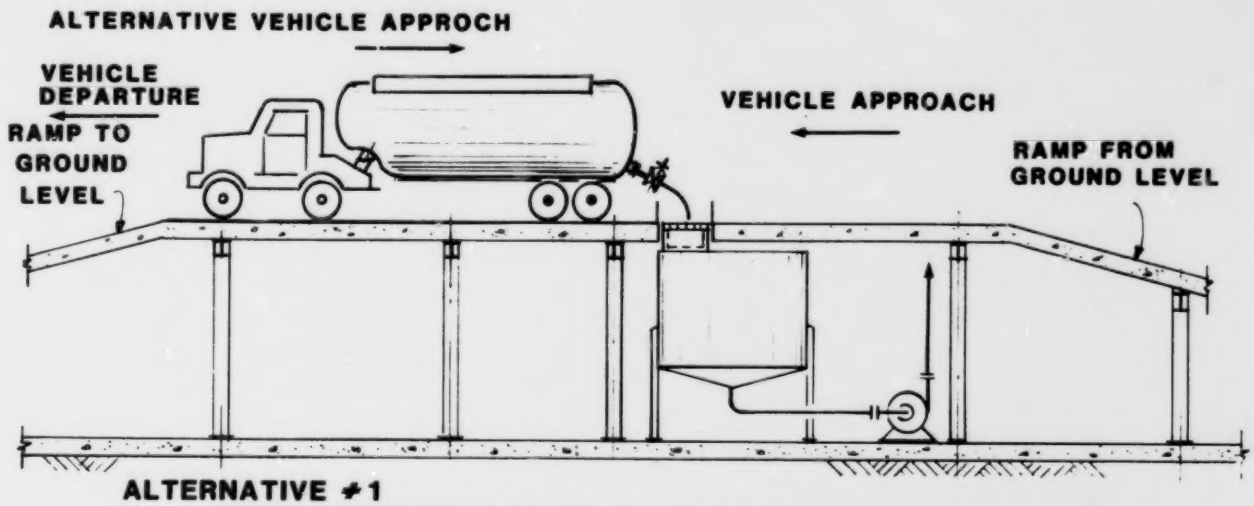
Vehicles unloading at ground level into tanks located below ground level, with the vehicles driving through the unloading station.

Alternative 3

Vehicles unloading at ground level into tanks located below ground level, but with the vehicles reversing to the unloading station.

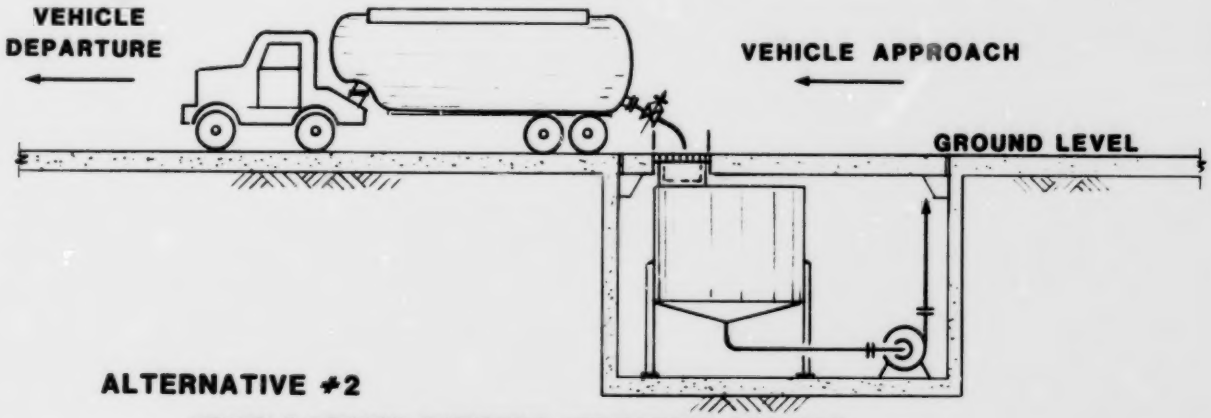
Alternative 1 has the following features:

- good traffic flow with the drive-through arrangement,
- waste unloading tank is located above ground level, eliminating the need for in-ground pits for the provision of double engineered containment (Chapter 4 p. xxx),
- containment of a major vehicle waste spill at the elevated unloading station would require careful consideration, offsetting the advantage of the previous point,
- the space required to construct approach and departure ramps to the elevated unloading stations would increase the area requirements for the central operating area,



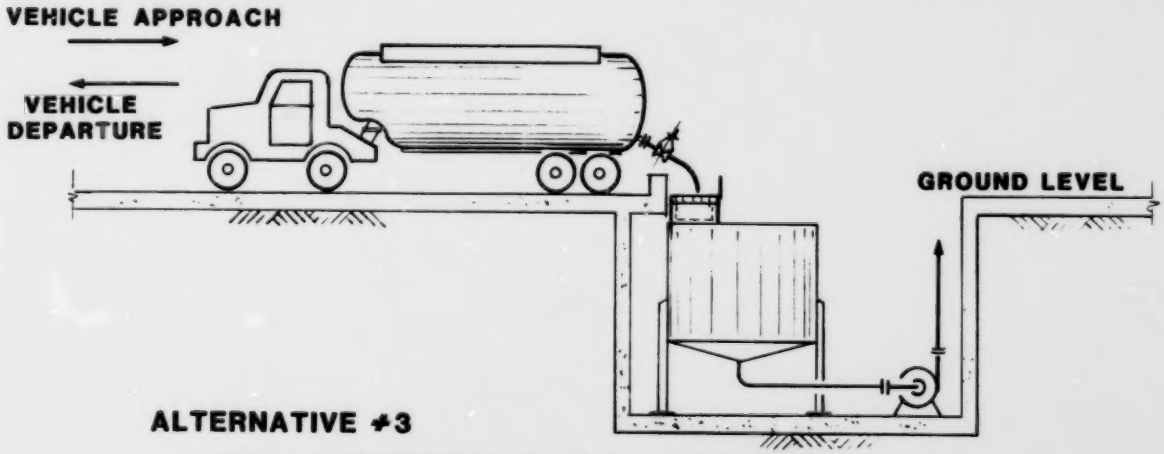
ALTERNATIVE #1

- VEHICLE REVERSING OR DRIVING THROUGH UNLOADING STATION.
- UNLOADING TANK AT GROUND LEVEL. VEHICLE ABOVE GROUND LEVEL.



ALTERNATIVE #2

- VEHICLE DRIVING THROUGH UNLOADING STATION.
- UNLOADING TANK BELOW GROUND LEVEL.



ALTERNATIVE #3

- VEHICLE REVERSING TO UNLOADING STATION.
- UNLOADING TANK BELOW GROUND LEVEL.

FIGURE 11

BULK UNLOADING STATIONS -ALTERNATIVE ARRANGEMENTS

- the cost of this alternative is higher than the other two options.

Alternative 2 has the following features:

- good traffic flow,
- minimum site space requirements,
- potential for fire hazard, particularly in the case of organics, since the tractor units must pass over the unloading tank inlet,
- potential exists for the spillage and/or splashing of waste onto areas of vehicle traffic, resulting in contamination of vehicle tires,
- increased difficulty in fugitive emission capture, since a clear passage through the unloading station must be provided for the vehicle, requiring the use of movable screens or shrouds to confine the fume capture area during the unloading activity,
- construction cost premium associated with the below ground structures since the vehicle must drive over the unloading tank.

Alternative 3 has the following features:

- traffic flow is acceptable, but inferior to options which avoid vehicle reversing,
- site space requirements are greater than Alternative 2 but substantially less than Alternative 1,
- potential for fire hazard arising from vehicle engines is minimized,

- o best arrangement for fugitive emission capture since the unloading area can be confined to the maximum extent, thereby enhancing the operation of the fume capture system,

- o similar unloading arrangements have proven satisfactory at several waste treatment installations, and

- o construction costs are minimized.

Overall it was evident that Alternative 3 best meets OWMC's goals in:

- o minimizing risk to human health (fire hazard, containment, fugitive emissions),

- o minimizing impact on the environment (space requirements, containment, fugitive emissions), and

- o minimizing costs.

5.2.5 DESIGN AND OPERATION

The arrangement and location of the bulk waste unloading facilities have been previously addressed in Chapter 3 (p. 21). This section deals with the design and operation of bulk waste unloading facilities for organic and inorganic waste.

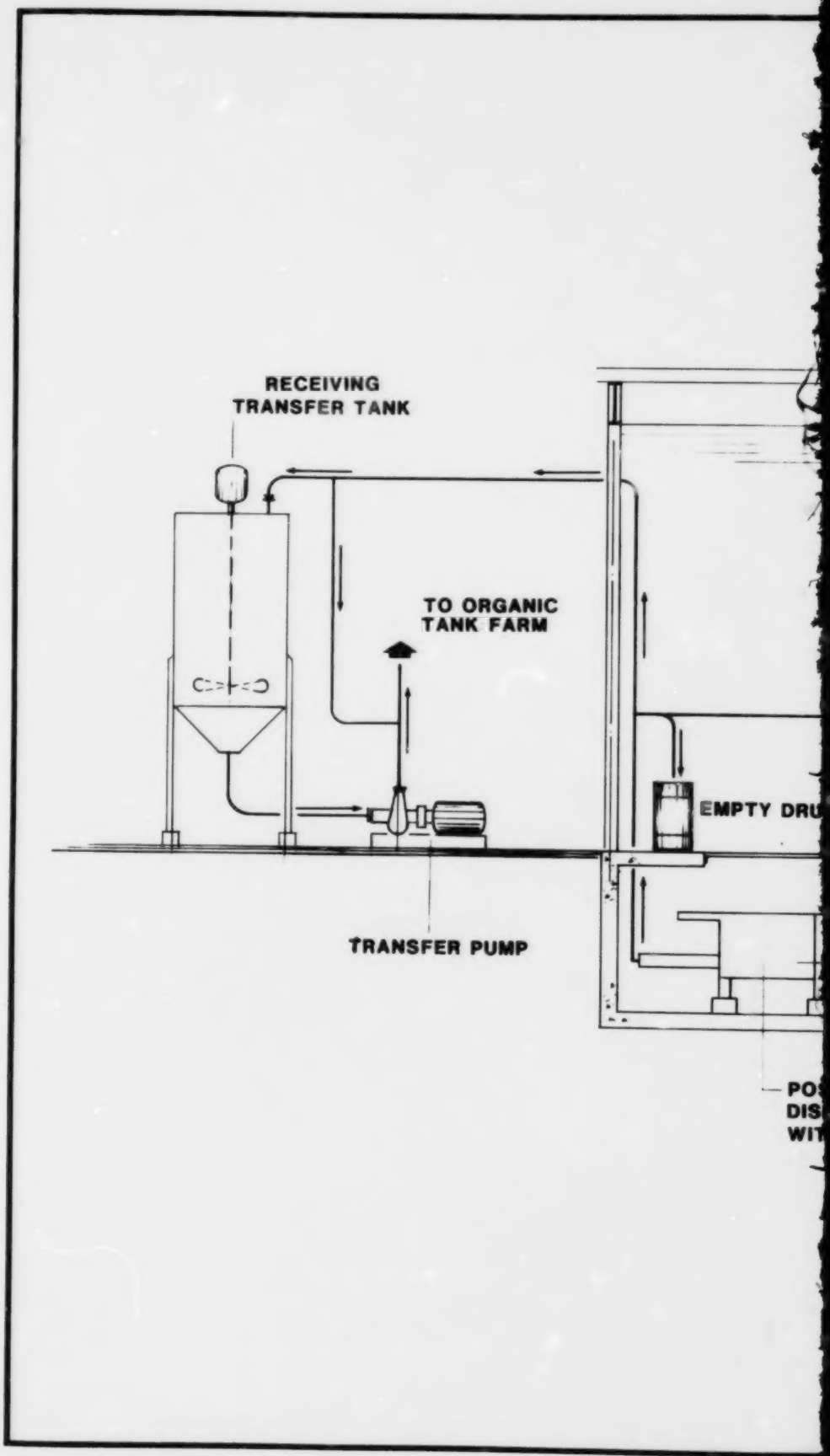
Organic Bulk Waste Unloading

Once directed to the appropriate unloading area, vehicles will reverse into the designated unloading station ready for unloading under the supervision of OWMC operations personnel.

Two distinct types of unloading stations are provided for organic wastes, as further described below:

Organic Unloading Station - Liquids/Sludges

This type of unloading station is illustrated in Figure 12. It will normally be used to unload bulk pumpable liquids and sludges containing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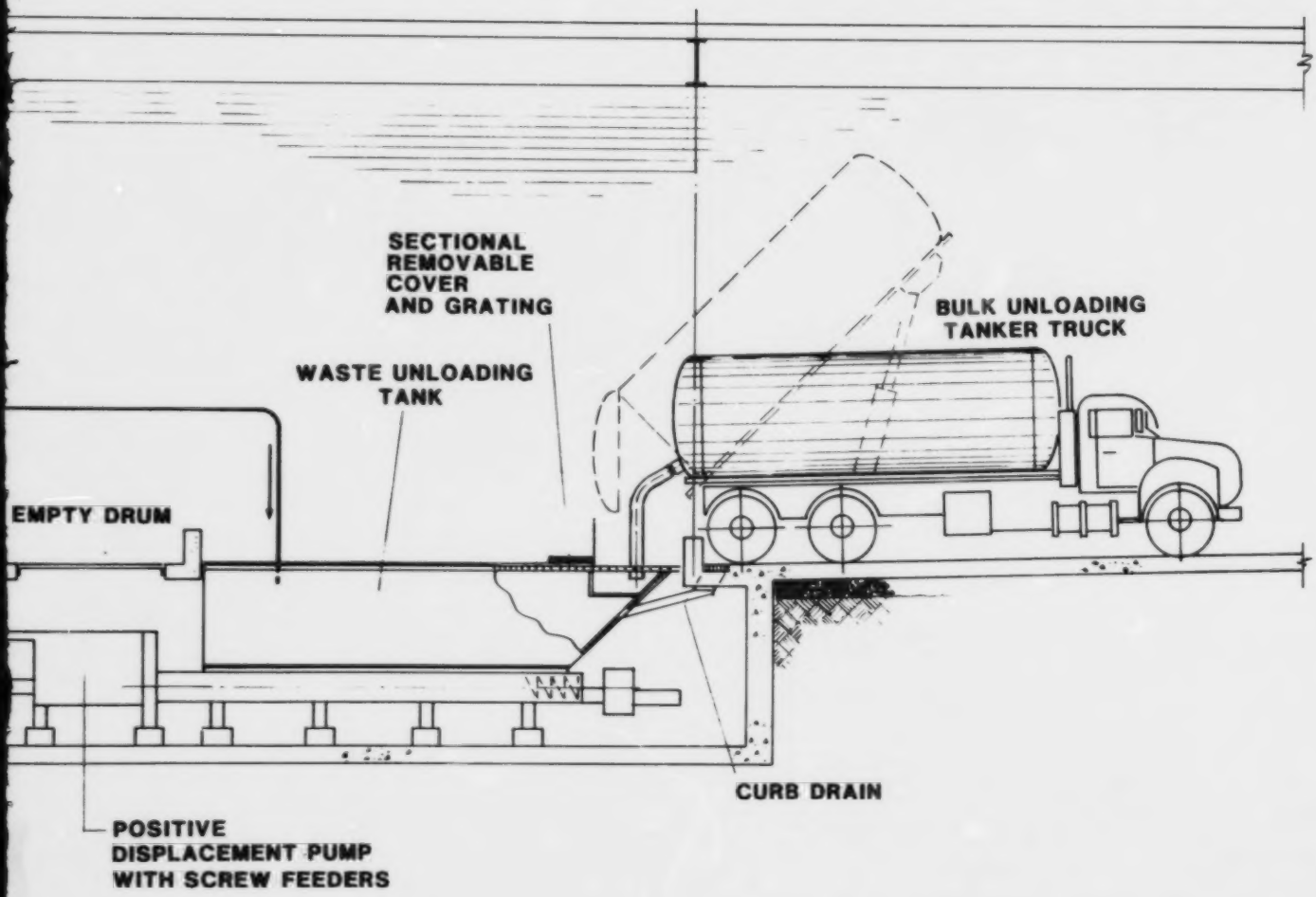


FIGURE 12
ORGANIC UNLOADING STATION
LIQUIDS AND SLUDGES
PICTORIAL SCHEMATIC

gross solids from special road tankers or containers. Vehicles can be unloaded to the inground receiving tank using:

- o the vehicles own unloading pump, or
- o by gravity flow.

Where gross solids are present, these can be removed by a basket screen in the top of the unloading tank. The removable basket will be periodically emptied and the gross solids transferred to either the incinerator bunkers or to drums for disposal by incineration.

Waste will be transferred from the unloading tank to an intermediate waste receiving tank, using a positive displacement pump.

Thick sludges which require dilution prior to being transferred to the intermediate waste receiving tank will also be unloaded at this type of station. Both sludge and dilution medium (oil or water) will be placed in the unloading tank and the contents recirculated using the positive displacement pump, prior to being transferred to the intermediate receiving tank. A connection will be provided in the recirculation piping to allow thick sludges to be transferred to drums if it proves impractical to render them readily pumpable by recirculation and liquid addition.

Since unloading of wastes containing gross solids and/or thick sludges will be by gravity, only vehicles capable of tipping or having large bottom or end discharge openings will be used for this service.

Organic Unloading Station - Liquids

This type of unloading station does not have an inground waste unloading tank, but includes a permanent unloading pump for the unloading of waste directly from the vehicle into an intermediate waste receiving tank.

It will be used to unload bulk pumpable liquids and sludges using:

- o the vehicle's own unloading pump, or
- o the permanent facility unloading pump referred to above.

This method of unloading is preferred whenever possible, since the transfer is achieved using closed piping systems connecting the vehicle tanker to the intermediate receiving tank.

Organic waste shipments can be transferred directly to the incinerator tank farm using the unloading station pump, where the shipments are compatible with the contents of the larger tanks in the incinerator tank farm. Organic wastes can also be pumped from either type of unloading station to the associated intermediate waste receiving tank if a particular shipment is not compatible with the existing contents of the storage tanks. This tank will be hopper bottomed to facilitate removal of sediment, and will be provided with an agitator and pump to transfer the waste to the storage tanks of the tank farm. Each tank and associated piping and equipment will be heat traced and insulated to prevent freeze-ups and to ensure good flow properties.

Each unloading station will be equipped with flushing connections to flush out the suction and discharge lines of the pumps. The flushing medium will be water, although, where necessary (e.g. for heavy organic residues or in cold weather) it will be supplemented by steam. After unloading a vehicle, any sludge or sediment remaining will be flushed, by liquid recirculation, and pumped out. The unloading hose will then be disconnected from the vehicle and allowed to drip drain into the unloading tank. The hose will then be flushed out with water/steam and its end capped.

Intermediate waste receiving tanks have been included in the design for the following reasons:

- o The availability of these tanks provides the flexibility to hold some shipments of waste for short periods before being routed to the organic storage tanks. This is desirable because the organic

storage tanks are relatively large, and mixing of different shipments of waste may be unacceptable and/or undesirable.

- It will facilitate the unloading of vehicles using their own pumps, where these pumps may not have sufficient head to pump waste directly to the storage tanks located in the Incinerator Tank Farm.

- The receiving tanks can serve as a primary separation tank for sludge or organic/water mixture, where appropriate.

Each of the unloading stations will be designed with sloped surfaces and curbs to ensure waste containment in the event of leaks/spills during unloading procedures. Additionally, the contained area of each unloading station, in conjunction with the below grade unloading tank, will be sized to contain 40 m^3 in the event of complete rupture of the maximum sized waste transport vehicle. Unloading stations not equipped with below grade unloading tanks will be fitted with trench drains connecting to the next adjacent below grade unloading tank. The contained area of each unloading station will have a tiled surface to provide chemical and wear resistance.

Double containment design, as more fully described in Chapter 4, will be employed for the parts of the unloading stations located below ground level. It will comprise concrete structures housing fabricated unloading tanks, pumps and associated piping systems. Extensive ventilation will be provided for personnel and operating safety, and vent systems will be incorporated to minimize fugitive emissions. Parts of the unloading system located below ground level will be monitored by hydrocarbon detectors and checked prior to personnel entry.

The unloading stations will be sheltered from the elements by a roof, sidewalls and one endwall. This will minimize the quantity of contaminated stormwater resulting from the unloading area, which would otherwise have to be treated in the Facility (Chapter 11, p. 187). In addition to providing weather protection, the enclosure will enhance the operation of the vent system in minimizing fugitive emissions. In this regard, the openings to the below grade unloading tanks will be fitted with gates which are closed

to minimize emissions. These tanks will be connected to an exhaust system which will draw air into the unloading tank minimizing vapour emissions when the gates are opened, as well as maintaining a negative pressure within the unloading tank when the gates are closed. The gates will only be opened when waste discharge by gravity dumping is required. Waste discharge by hose will be through an auxiliary opening.

All intermediate waste receiving tanks will be subjected to slight negative pressure to ensure vapours are removed from the area to minimize the possibility of fires and/or explosions from hydrocarbon vapour/air mixtures.

Further details of all venting systems are provided in Chapter 12.

System Sizing

The bulk organic waste unloading stations will be sized based on the following criteria:

- 30 000 t/a of organic waste and 5 300 t/a of high water content aqueous organic waste to be unloaded, as determined from OWMC's waste data for the initial plant capacity of 150 000 t/a.
- waste will be delivered 50 weeks/a, 5 days/week,
- average vehicle waste load will be 15 t,
- unloading and transfer pumps will be sized to unload the average 15 t tank truck in 20 minutes while the turn-around time for the average tanker is conservatively allowed to be one hour, comprising 20 minutes for unloading and 40 minutes for hose connection, flushing out, and hose disconnection,
- operation of the system is 7 h/day (i.e. each unloading station can unload 7 trucks/day average), and

- o to provide flexibility, sufficient extra bays will be provided to unload approximately twice the estimated amount of any one type of waste.

The resulting total number of unloading stations required for organic waste is shown on Table 3 for both the initial plant capacity of 150 000 t/a and ultimate capacity of 300 000 t/a.

Four unloading stations will be installed initially and the need for an extra station, should the Facility be expanded to its ultimate proposed capacity, will be determined based on prior operating experience. Space has been provided in the Facility layout for this purpose.

A review of OWMC's waste data resulted in a provision for two unloading stations for pumpable liquids and sludges, and two unloading stations with inground unloading tanks for unloading liquids and sludges containing gross solids.

The number of unloading stations has been established to avoid any bottleneck due to any increase in the number of trucks or in the types of wastes arriving per hour.

The equipment and piping associated with the unloading facility will be of carbon steel construction except one pre-designated station which will have acid resistant material. It is anticipated that most organic wastes will be delivered to the Facility in a neutralized state. In the event that some acidic aqueous organic waste is delivered, it can be neutralized in the unloading tank or the receiving tank of the pre-designated unloading station prior to being transferred to the tank farm. The use of carbon steel construction down stream of the unloading facility is therefore practical.

The two below grade unloading tanks will be sized at 25 m^3 (25 t). This size has been selected as a compromise between flexibility in operation, construction cost, and the desire to minimize below grade

TABLE 3

ORGANIC WASTE UNLOADING STATIONS

150 000 t/a Facility

	t/a	trucks/day average	No. of Stations required	Stations to provide flexibility	Spare Stations
Organic Waste	30 000	8	1.1 allow 2	2.2 allow 3	not required
High Water Content Aqueous Organic	5 297	1.4 allow 2	0.2 allow 1	0.4 allow 1	not required
Total	35 297	9.4 allow 10	1.3 allow 3	2.6 allow 4	not required

300 000 t/a Facility

	t/a	trucks/day average	No. of Stations required	Stations to provide flexibility	Spare Stations
Organic Wate	60 000	16	2.3 allow 3	not required	1
High Water Content Aqueous Organic	10 594	2.8 allow 3	0.2 allow 1	not required	0
Total	70 594	18.8 allow 19	2.7 allow 4	not required	1

facilities for safety and containment reasons. The 25 m^3 size allows sufficient reserve volume over the average expected 15 t vehicle load for re-slurrying procedures to render sludges readily pumpable by liquid addition and pumped recirculation. In addition, to provide the necessary 40 m^3 containment in the event of complete rupture of the largest waste transport vehicle, only 15 m^3 need be retained in the curbed area of each unloading bay. This volume can be contained without recourse to high curbs.

It follows that vehicle loads in excess of 25 t being unloaded via the below grade unloading tank will require staged unloading procedure or concurrent transfer to storage with unloading. Neither of these alternative procedures will pose operational difficulties.

All of the above grade intermediate receiving tanks will be sized for 40 m^3 (40 t), equal to the largest waste transport vehicle capacity.

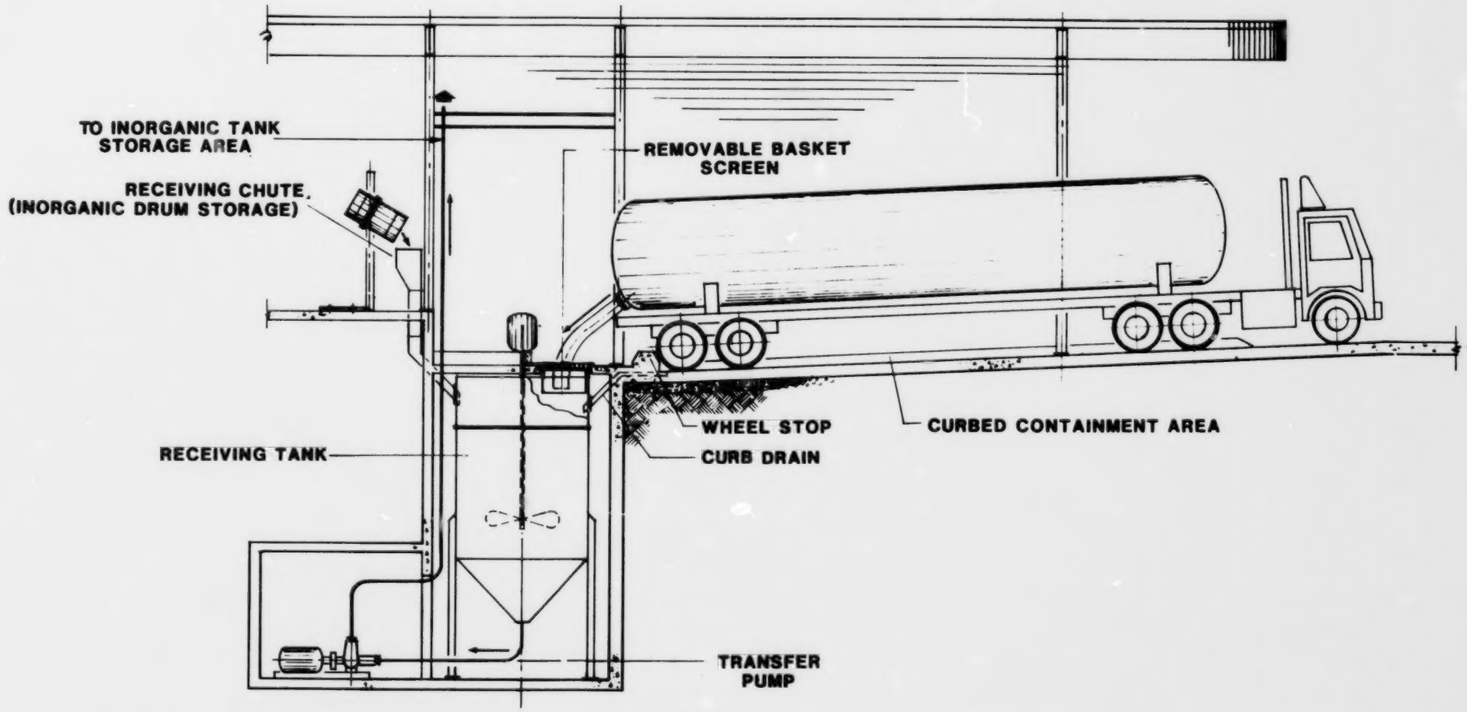
Inorganic Bulk Waste Unloading

Once directed to the appropriate unloading area, vehicles will reverse into the designated unloading station ready for unloading under the supervision of OWMC operations personnel.

All inorganic unloading stations are of similar design as illustrated on Figure 13. Each station has the capability to unload vehicle contents directly to a storage tank located in the Physical/Chemical Storage Tank Area using:

- the vehicle's own unloading pump, or
- the permanent facility unloading pump.

Direct unloading to a storage tank is the proposed unloading method where the waste is pumpable and is known to be free of gross solids, since it minimizes the potential for fugitive emissions at the unloading station.



NOTE:

_ DIRECT UNLOADING OF VEHICLE TO STORAGE CAN ALSO BE DONE

FIGURE 13

INORGANIC BULK WASTE UNLOADING PICTORIAL SCHEMATIC

Each unloading station will have the capability to unload vehicle contents to an in-ground receiving tank using:

- o the vehicle's own unloading pump, or
- o by gravity flow.

Where gross solids are present, they will be removed by a basket screen in the top of the unloading tank. Solids retained on the screen will be removed periodically and transferred to the solidification plant for size reduction prior to further appropriate treatment.

This method of unloading, via the unloading tanks, will be used for wastes containing gross solids, and for thick sludges which may require pretreatment (dilution) in the unloading tanks prior to being transferred to the storage tanks. Dilution will be achieved by adding waste and water in the unloading tank, and by using the tank mixer. Experience from European waste treatment facilities indicates that this method of unloading is safe procedure for inorganic wastes.

The inorganic unloading stations do not require intermediate receiving tanks since the waste storage tanks in the physical/chemical tank storage area are of vehicle tanker, i.e. batch, size. (See Chapter 6, p. 106).

Inorganic wastes will therefore be pumped from the unloading station directly to a designated storage tank in the physical/chemical tank storage area.

Equipment and procedures for flushing pump suction and discharge lines and for flushing sludge or sediment remaining in the transport vehicle cargo hold will be similar to that previously described for the organic unloading system.

Review of the Waste Profile and operating experience from European waste treatment facilities indicates that it will not be necessary to provide the feature for transferring the wastes to drums.

Since unloading of wastes containing gross solids and/or thick sludges will be by gravity, only vehicles capable of tipping or having large bottom or end discharge openings can use this service.

Design features of the inorganic stations with respect to containment, surface finishes, ventilation systems and weather protection will be similar to those previously described for the organic unloading systems, with the following exceptions:

- The parts of the inorganic unloading system which are below ground level will be larger than those of the organic unloading system, due to the greater number of unloading stations and their configuration. To ensure personnel and operating safety, separation will be provided between each below grade unloading tank, the unloading pumps, and below grade access ways to enable more effective ventilation and monitoring.

- At the inorganic unloading stations all of the below grade tanks will be provided with connections to allow the unloading of inorganic drum wastes into the unloading tanks from the adjacent inorganic drum handling building (Refer to Chapter 7). For the 150 000 t/a Facility four of these connections will be operative with the remainder available for future expansion.

- Spill catchment areas at the unloading stations will be finished with chemical resistant tiles.

System Sizing

The bulk inorganic unloading stations have been sized based on the following criteria:

- Inorganic waste deliveries are as follows, based on OWMC's Waste data for the initial plant capacity of 150 000 t/a:
  - Acidic liquids/sludges - 24 837 t/a
  - Alkali and neutral inorganics - 54 767 t/a

- Non-pumpable inorganics - 35 099 t/a
  Total - 114 703 t/a

o The non-pumpable inorganic waste stream was distributed between acidic and alkali categories on a prorated basis, as indicated below:
  - Acidic liquids/sludges - 35 788 t/a
  - Alkali and neutral inorganics - 78 915 t/a
    Total - 114 703 t/a

o All other sizing criteria are the same as previously used for the organic unloading system on page 78.

The resulting number of unloading stations required for inorganic waste is shown on Table 4 for both the initial plant capacity of 150 000 t/a and ultimate capacity of 300 000 t/a.

Nine inorganic unloading stations will be installed initially and space has been provided in the Facility layout for an additional four stations in the future.

The number of unloading stations has been established to avoid any bottleneck due to any increase in the number of trucks or in the types of wastes arriving per hour.

Additional flexibility is incorporated into the unloading system by the choice of materials for the system components. All unloading tanks, system equipment and piping will be of fibreglass reinforced plastic construction, which will allow the use of all nine unloading stations for acidic, alkaline and neutral wastes on an interchangeable basis. However, unloading stations are likely to be designated to cater to specific inorganic waste categories.

TABLE 4

INORGANIC WASTE UNLOADING STATIONS

150 000 t/a Facility

	t/a	trucks/day average	No. of Stations required	Stations to provide flexibility	Spare Stations
Acidic liquids/sludges	35 788	9.5 allow 10	1.3 allow 2	2.6 allow 3	not required
Alkali/neutral inorganics	78 915	21	3	6	not required
Total	114 703	30.5 allow 31	4.3 allow 5	8.6 allow 9	not required

300 000 t/a Facility

	t/a	trucks/day average	No. of Stations required	Stations to provide flexibility	Spare Stations
Acidic liquids/sludges	71 576	19.1 allow 20	2.7 allow 3	not required	2
Alkali/neutral inorganics	157 830	42.1 allow 42	6.01 allow 6	not required	2
Total	229 406	61.2 allow 62	8.71 allow 9	not required	4

The design of spill containment systems and ventilation systems to minimize occupational health risk and release of fugitive emissions to the environment, will be similar to those previously described for the organic waste unloading stations on p. 75.

Unloading tanks will be 25 m^3 capacity based on the same rationale presented for organic waste unloading tanks on p. 78.

5.3 TRUCK WASH

5.3.1 PURPOSE

The truck wash station provides facilities for washing bulk waste tanker vehicles after unloading for which a charge will be made.

5.3.2 DESIGN CRITERIA

The criteria adopted for design of the truck wash are as follows:

- Facilities will be included for internal washing of waste hauling tankers,
- The truck wash will be sized to wash 25% of waste tankers expected at OWMC's Facility, since industry practice is to use tanker vehicles for extended periods in a similar service, and in such cases washing will not be necessary,
- Two separate installations will be provided for vehicles hauling organic and inorganic waste, to avoid cross contamination of wash water,
- Washing will be done with a high pressure stream of warm alkaline water, with the capability to add other cleaning chemicals if required, as determined by laboratory analysis,

- o The wash system liquid for inorganic waste tankers will be maintained in an alkaline state so that residues of cyanide and/or sulphide-bearing wastes will not foam or release toxic gases,

- o Contain washing operations in an enclosed cleaning area fitted with doors at each end, to allow truck entry and exit in a drive through manner, and facilitate capture of potential fugitive emissions.

5.3.3 ALTERNATIVES CONSIDERED

Two fundamental alternatives were addressed in establishing the conceptual design of truck wash facilities, namely:

- o Should the design include provisions for washing of both interiors and exteriors of vehicles, or only interiors, and

- o Should the equipment be located indoors or outdoors.

5.3.4 EVALUATION OF ALTERNATIVES

OWMC decided the inclusion of a truck wash at the Facility was necessary for the following reasons:

- o It was considered the interior of the truck should be washed at the Facility so that the wash water can be collected for treatment.

- o It was considered that only those parts of the vehicle that come into contact with waste will be washed and the water collected for treatment. Hence, it was considered not necessary to provide washing facilities for the outside of the truck.

It was decided the truck wash will be enclosed to:

- o minimize the amount of contaminant stormwater which would otherwise require treatment on-site,

- o minimize fugitive gaseous emissions to the environment, and
- o permit year round operation.

5.3.5 DESIGN AND OPERATION

Figure 14 illustrates the conceptual design of the proposed truck wash at OWMC's Facility. Two similar systems will be provided, one for tankers which have delivered organic waste, and the other for tankers which have carried inorganic waste.

Separate wash systems will be provided to maintain separation of organic and inorganic waste residuals and to ensure separation between organic and inorganic fugitive emissions. Separate vent systems will also be installed at each wash system.

Each wash system will consist of a below-ground holding tank, a circulating pump, a set of rotary tank wash nozzles and associated instrumentation and vent systems.

The washing solution from the tanker, will be returned to a holding tank located below ground level, either through a hose or by gravity via a drainage trench for reuse.

Tank trucks will be washed with recirculated washing solution for approximately 20 minutes and then rinsed for an additional 10 minutes with fresh service water.

After each truck wash, the concentration of caustic soda in the organic truck wash tank, and the pH in the inorganic truck wash tank, will be checked and additional caustic soda solution will be added, if required.

The concentration of contaminants in the holding tanks will be periodically checked and the holding tank will be emptied whenever the wash water needs replacement.

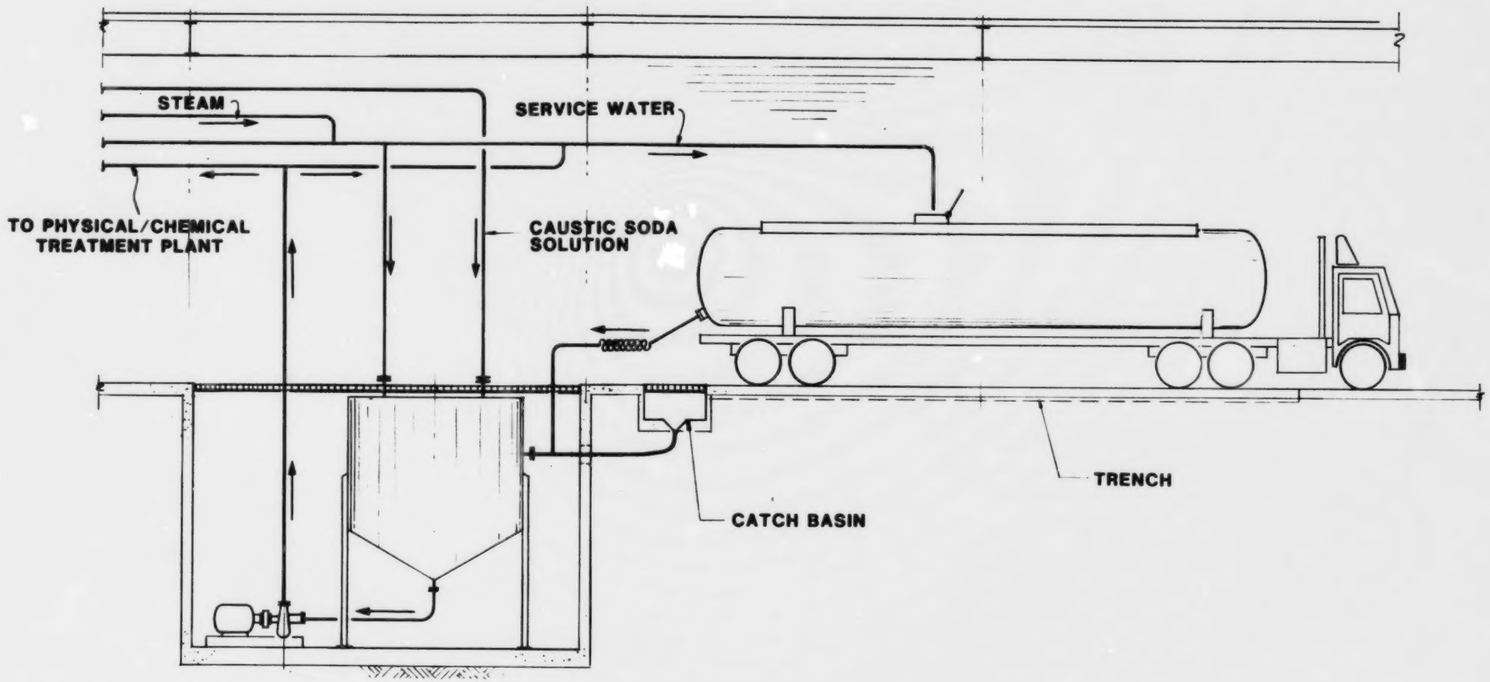


FIGURE 14

TANK TRUCK WASHING FACILITY PICTORIAL SCHEMATIC

The holding tanks will be emptied by transferring their contents to the physical/chemical treatment plant for treatment.

Each of the washing systems will comprise an enclosed bay with doors fitted at each end, allowing drive through passage for the waste tankers.

In addition to providing weather protection, the enclosure will enhance the operation of the vent system to capture fugitive emissions. The sidewalls of each bay will incorporate air extraction louvers located near ground level to ensure fume capture at the point of discharge from the vehicles. Further details of all venting systems are provided in Chapter 12.

The floor of the cleaning area will be paved with reinforced concrete and tiled to provide chemical resistance. Raised curbs will be provided to contain spills, and a drainage trench down the centre of each bay will drain to a sump covered with load bearing, corrosion resistant grating. From the sump the liquid will drain to the wash solution holding tank which will be located below ground level.

The need for system equipment to be located below ground level, requires that all equipment (e.g. pumps, tanks, piping etc.) be arranged so that any spills and leaks are contained within the structure housing the equipment, thereby providing effective double containment of fluids handled in the system, as fully explained in Chapter 4 p. 42.

All system components will be fabricated from carbon steel. This choice of materials can be made for both truck wash systems since all organic wastes will be neutralized prior to shipment to the Facility and all acidic inorganic waste residuals in the vehicle will be neutralized by the highly alkaline washing solution.

System Sizing

Approximately 8 tank trucks of organic waste and 32 trucks of inorganic waste are expected daily at OWMC's Facility, when operating at the initial

planned capacity of 150 000 t/a. This is based on an average vehicle waste load of 15 t, and conservatively assumes that all waste is delivered in tank trucks.

The truck wash will be designed for 25% of these vehicles, equivalent to approximately 2 trucks/day for the organic truck wash and 8 trucks/day for the inorganic truck wash.

Since a wash and rinse cycle requires slightly in excess of 30 minutes, each truck wash station will be capable of washing 15 vehicles per day in 8 hours, providing ample margin for variations in the actual number of trucks requiring washing, and the likelihood that certain periods during the day will be busier than others.

The need for additional truck wash facilities, in the event that OWMC's Facility is expanded to its ultimate proposed capacity of 300 000 t/a, will be determined based on operating experience. Space has been allocated on the site plan for additional truck wash facilities, if required in the future.

CHAPTER 6
TANK FARM AND STORAGE TANK AREA

6.1 INTRODUCTION AND PURPOSE

Chapter 5 described the various forms in which waste will be delivered and unloaded at OWMC's Facility. It focused on the unloading and transfer to storage of bulk deliveries of pumpable wastes. This chapter addresses the storage of organic pumpable wastes in the incinerator tank farm, and the storage of pumpable inorganic wastes in the physical/chemical storage tank area.

The purpose of these waste storage facilities is to provide adequate capacity of waste storage which:

- o is safe,
- o provides separation for different types of wastes,
- o provides for pretreatment such as phase separation in the storage tanks, and
- o permits mixing of wastes, where required, prior to treatment.

6.2 DESIGN CRITERIA

The criteria established for design of bulk pumpable waste storage facilities are as follows:

- facilities will include sufficient flexibility in storage capacity and separation of batches to accommodate the expected fluctuations in waste quantities and characteristics, as well as interruptions to the rate of treatment which will arise during periods of plant maintenance,

- the design and layout will be developed to satisfy operability, fire, safety and environmental protection requirements,

- it will include storage capacity for process water used for slurrying wastes in bulk unloading basins,

- it will allow for on-site generated wastes such as wash liquids from floor washing, equipment flushing and spills to be pumped via the wash liquid piping or the waste transfer lines to the storage areas,

- it will permit transfer of aqueous organic wastes between the incinerator tank farm and the physical/chemical tank storage area, if required,

- it will allow for the direct unloading and segregated storage of certain organic wastes such as PCB's, pesticides, etc.

- it will provide blending tanks for organic wastes,

- the operation, supervision and process controls of the tank farm and storage tank systems will be integrated with the processing systems they serve.

6.3 ALTERNATIVES CONSIDERED

The only fundamental alternative considered in the design of these facilities, was whether the storage tanks should be located indoors or outdoors.

The design of these waste storage facilities was developed by:

- o gathering information from similar operating plants in Europe and the USA,
- o reviewing regulatory requirements, and by
- o using experience from the design of other tank storage installations.

Particular emphasis was placed on experience at other similar installations provided by OWMC's Technology Consultants.

6.4 EVALUATION OF ALTERNATIVES

An assessment of indoor and outdoor storage confirmed that either option was technically possible for both organic and inorganic materials.

Outdoor location of organic waste storage tanks was preferred for the following reasons:

- o Access to the storage tanks, in the event of fire, is more easily accomplished in an outdoor installation.
- o Occupational health risks are lower, when dealing with a major tank spill in an outdoor installation.

- Protection against freezing is not a major consideration with organic waste, and tanks containing aqueous organics can be adequately protected by heat tracing and insulation.

- Safety features required to protect against spills, fires and explosions can be provided at significantly lower cost in an outdoor installation.

Overall, it was considered that OWMC's goals for minimizing risk to human health, impact on the environment and cost, could be best achieved by locating these storage tanks outdoors. This is also consistent with proven practice in similar operating facilities in Europe and the U.S.A.

Indoor location of inorganic waste storage tanks was preferred for the following reasons:

- The inorganic waste storage tanks will form an integral part of the physical/chemical treatment plant from a process perspective, being used extensively for blending, sampling and phase separation, and the operational convenience of not only locating these tanks close to the physical/chemical treatment plant, but also indoors, will enhance plant operability and as a consequence, operational safety.

- The risk of fire is extremely low, since the inorganic wastes are non-combustible. Special precautions can be taken in the enclosure of aqueous organic waste storage tanks located in this area.

- The size of individual storage tanks is significantly smaller than in the storage of organic wastes, and major spills can be more readily contained and dealt with.

- Frost protection is an important consideration for the storage of inorganic wastes, since most of the wastes have high water content.

Overall, it was concluded that OWMC's goals of minimizing risk to human health and the environment are best achieved by locating these

storage tanks indoors. The improved plant operability, which is directly related to occupational safety, was considered to justify the additional cost of enclosing these tanks. This is also consistent with proven practice in most similar operating facilities elsewhere in the world.

6.5 DESIGN AND OPERATION

This section addresses the design and operational considerations of the pumpable waste storage facilities. The incinerator tank farm and physical/chemical storage tank area are dealt with separately, below.

6.5.1 INCINERATOR TANK FARM

The design of the incinerator tank farm is shown diagramatically on Figure 15.

It is necessary, for safety and operability considerations, for the tank farm to operate as an extension of the incineration plant and all waste transfers to and from the tank farm will be coordinated from the incineration plant control room.

The transfer of organic waste to the incinerator tank farm from the organic tank truck unloading bays, from the organic drum storage and handling building, and from tankers unloading waste that goes to the segregated storage tanks and handling will be scheduled in conjunction with incineration plant operating personnel. Similarly the pre-processing of organic wastes (blending, phase separation, slurrying) will be undertaken in conjunction with incineration plant operating personnel, as will the transfer of organic wastes from the tank farm to the incineration plant. For aqueous organic wastes requiring pretreatment in the physical/chemical treatment plant, the transfers of waste to and from the incinerator tank farm will be coordinated by the operating personnel of both plants who will liaise closely with each other and the waste scheduler.

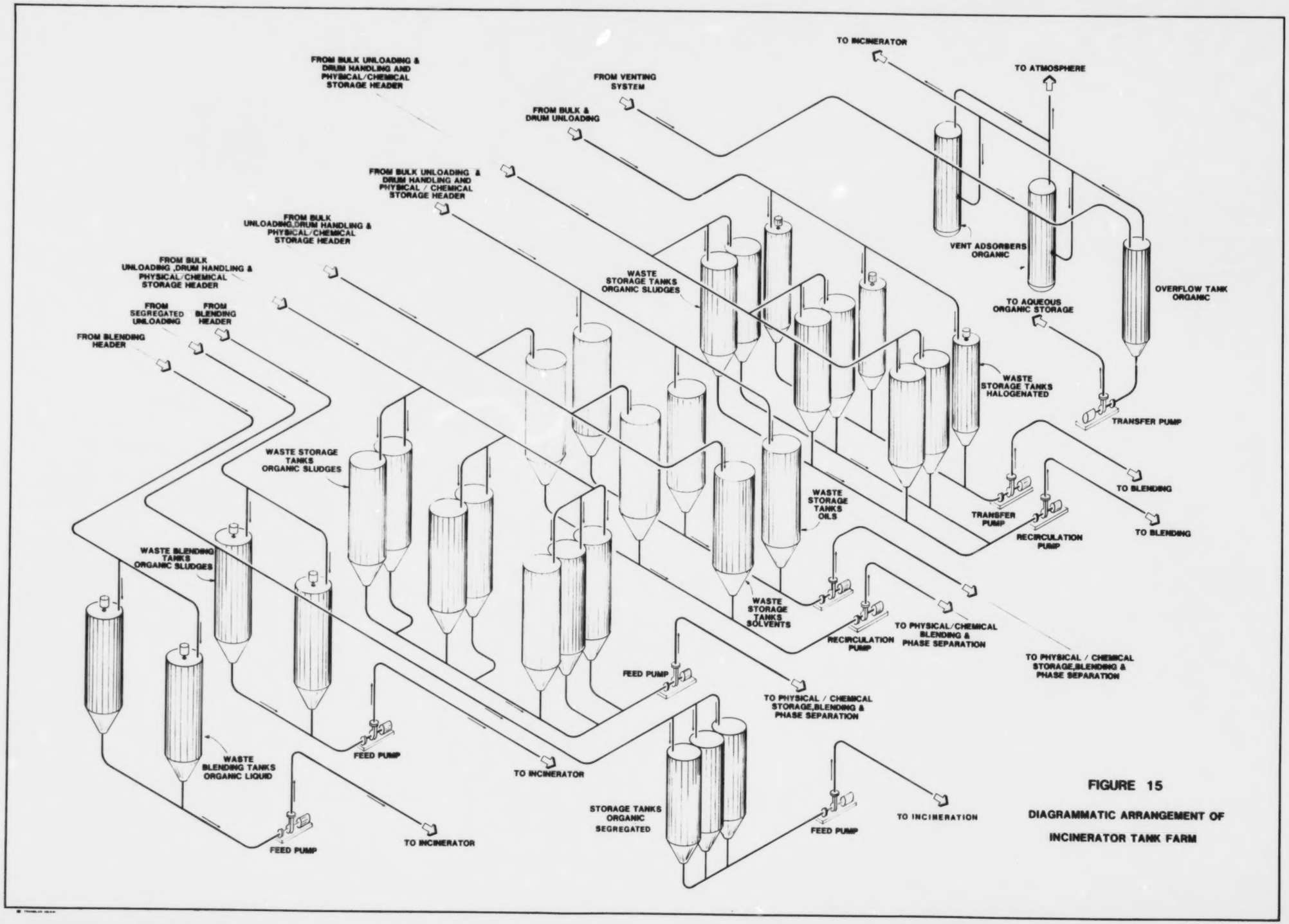

FROM BULK UNLOADING & DRUM HANDLING AND PHYSICAL/CHEMICAL STORAGE HEADER
FROM VENTING SYSTEM
TO INCINERATOR
TO ATMOSPHERE
FROM BULK & DRUM UNLOADING
FROM BULK UNLOADING & DRUM HANDLING AND PHYSICAL / CHEMICAL STORAGE HEADER
FROM BULK UNLOADING,DRUM HANDLING & PHYSICAL/CHEMICAL STORAGE HEADER
FROM BULK UNLOADING ,DRUM HANDLING & PHYSICAL/CHEMICAL STORAGE HEADER
FROM SEGREGATED UNLOADING
FROM BLENDING HEADER
FROM BLENDING HEADER
WASTE STORAGE TANKS ORGANIC SLUDGES
WASTE STORAGE TANKS ORGANIC SLUDGES
VENT ADSORBERS ORGANIC
OVERFLOW TANK ORGANIC
TO AQUEOUS ORGANIC STORAGE
WASTE STORAGE TANKS HALOGENATED
TRANSFER PUMP
WASTE STORAGE TANKS OILS
TRANSFER PUMP
RECIRCULATION PUMP
TO BLENDING
TO BLENDING
WASTE BLENDING TANKS ORGANIC SLUDGES
WASTE STORAGE TANKS SOLVENTS
RECIRCULATION PUMP
TO PHYSICAL/CHEMICAL BLENDING & PHASE SEPARATION
TO PHYSICAL / CHEMICAL STORAGE,BLENDING & PHASE SEPARATION
FEED PUMP
TO PHYSICAL / CHEMICAL STORAGE,BLENDING & PHASE SEPARATION
FEED PUMP
TO INCINERATOR
WASTE BLENDING TANKS ORGANIC LIQUID
STORAGE TANKS ORGANIC SEGREGATED
FEED PUMP
TO INCINERATION
FEED PUMP
TO INCINERATOR

FIGURE 15

DIAGRAMMATIC ARRANGEMENT OF INCINERATOR TANK FARM

The waste storage tanks will be divided into the following groups:

- o Aqueous Organic
- o Waste Solvent
- o Waste Oil
- o Sludges
- o Halogenated Waste
- o Segregated
- o Blending (liquids and sludges)

Each group of tanks will contain two or more tanks, thereby enabling further separation of waste on the basis of characteristics. Furthermore, the designation of each tank or group of tanks can be changed based on operating experience.

Four pump-out headers, one header for each organic bulk unloading station, will transfer waste from the unloading area. Three headers will be provided from the drum handling building; one header for organic liquids, one for organic sludges, and the other for aqueous organics. Valves, remotely operated from the incineration plant control room, will direct the wastes to the designated tanks.

Aqueous organic wastes will be pumped from the unloading stations either to the aqueous organic tanks in the incinerator tank farm or to the aqueous organic tanks in the physical/chemical tank storage area, depending on processing strategy. The tank farm will receive those shipments designated for incineration or for phase separation prior to transfer to the physical/chemical plant for processing.

Important features of each storage tank grouping are described in the following paragraphs.

Aqueous Organic

Aqueous organic storage consists of seven tanks with a storage volume of 120 m^3 each. Feed to the storage tanks can be from bulk unloading, drum handling or from the aqueous organic storage in the physical/chemical area.

Valves, remotely operated from the incineration plant control room, will direct the waste into the designated storage tank.

Each tank will be provided with a pump to serve the following functions:

- recirculation/mixing of tank contents,
- pumping of accumulated sludge from tank bottom to the sludge tanks, and
- pump-out of a separated aqueous phase to the physical/chemical storage area.

Remotely operated valves will be provided for directing waste to the designated receiving tank or re-circulating back to storage and the pumps will be remotely started and stopped.

A common incinerator feed pump will be provided, which can draw from any one of the seven aqueous organic storage tanks. A re-circulating line from the incinerator kiln front wall will be provided to prevent settling of solids in the feed line, with recirculation directed back to the operational tank. Remotely operated valves will be provided for selection of storage tank for pump suction and re-circulation, and the pump will be started remotely.

Waste Solvent

Waste solvent storage consists of three tanks with a storage volume of 120 m^3 each. Feed to the tanks, valve operation and recirculation/pump-out will be indentical to the aqueous organic storage except that the waste solvent will be pumped to blending tanks instead of directly to the incinerator.

Waste Oil

Waste oil storage and operation will be identical to the waste solvent tanks.

Organic Sludges

Organic sludge storage consists of six tanks with a storage volume of 120 m^3 each. Feed to the storage tanks can be from bulk unloading, drum handling, aqueous organic storage tanks in the incinerator tank farm, waste oil storage tanks or from the waste solvent storage tanks.

Remotely operated valves will direct the waste into the designated storage tank. Each tank will be provided with a pump to serve the following functions.

- recirculation/mixing of tank contents, and
- pump-out to blending tanks

Remotely operated valves will be provided for directing waste to the designated receiving tank or re-circulating back to storage and the pumps will be remotely started and stopped.

Halogenated Waste

Certain halogenated hydrocarbon wastes will be stored in separate tanks as determined by waste characteristics.

Halogenated waste storage consists of three tanks, each with an agitator and a storage volume of 10 m^3. Feed to the storage tanks can be taken from bulk unloading or drum handling and remote operated valves will direct the waste into the designated storage tank.

A common pump will be provided to transfer waste to blending tanks. Suction will be taken from any one of the three halogenated waste storage tanks with remote operated valves provided for selection of storage tank for pump suction and for directing waste to the designated receiving tank.

The relatively small capacity of these tanks was determined following the results of health risk assessment, which identified that the quantity of certain types of wastes stored in a single tank should be restricted to limit the potential release to atmosphere in the event of a discharge of tank contents during a fire.

Segregated Storage

Storage facilities are provided for segregated wastes, such as polychlorinated biphenyls, that require segregated unloading and storage.

After passing through reception procedures which include weighing and checking of manifest papers, trucks containing segregated wastes will be directed to the segregated storage facility in the incineration tank farm.

The facility consists of an unloading pump, three segregated storage tanks, each with an agitator and a storage capacity of 40 m^3, and an incinerator feed pump.

The waste will be unloaded into any one of the three storage tanks with remote operated valves directing the waste into the designated storage tank.

A common incinerator feed pump will draw from any one of the three segregated storage tanks. A recirculating line from the dual burner will be provided to prevent settling in the incinerator feed line with recirculation directed back to the tank from which the pump is taking suction. Remote operated valves will be provided for selection of storage tank, for pump suction and for re-circulation. The pump will be started remotely from the incineration plant control room.

A cross connection will be provided to enable transfer of waste between segregated storage tanks but it will not be possible to transfer waste from the segregated storage system to any other storage tank.

The segregated waste unloading and storage facility will be fenced with a locked access gate. Entrance to this area will be restricted.

Waste Blending-Liquids

The liquid waste blending category consists of two tanks, each with an agitator and a storage volume of 60 m^3. Feed to the blending tanks can be from organic solvents storage tanks, organic oils storage tanks,

halogenated waste storage tanks, or from the aqueous organic storage tanks in the incinerator tank farm. Remote operated valves will direct the waste into the designated blending tank.

A common incinerator feed pump will feed from any one of the two blending tanks. A recirculating line from the incinerator feed will be provided to prevent settling in the incinerator feed line, with recirculation directed back to the operating tank. Remote operated valves will be provided for selection of storage tank for pump suction and for recirculation. The pump will be started remotely. An additional pump will be provided for recirculating back to the blending tanks.

In normal operation, one blending tank will be in service while the second tank is being prepared for service. The reasons for including blending tanks are addressed in the Process Area Report - Incineration (Ref: Monenco Limited[6]).

Waste Blending - Sludges

The sludge waste blending system also consists of two tanks and is identical to the liquid waste blending with the exception that it can also draw from the organic sludge tanks.

Auxiliary and Safety Systems

The storage tanks will be located in concrete dykes to provide two levels of engineered containment, and as required by engineering codes, as further addressed in Section 4.2.3 (p. 43).

The organic storage tanks will be internally blanketted with nitrogen to protect against explosion and fire. Common nitrogen supply systems will be provided for the tanks of the tank farm and the unloading area receiving tanks while the segregated waste storage tanks will have a separate nitrogen supply system. The nitrogen will be controlled to maintain a minimum pressure of about 14 kPa gauge and the vent gases from the tanks will be piped via an overflow tank to the incinerator, where the organics in the vent gas will be destroyed. An auxiliary filtration system will be provided to remove organics from the vent nitrogen prior to it being

released to atmosphere, in the event that the incinerator is not operating. A similar, but separate system is proposed for the segregated storage tanks.

Each vent system will have vacuum relief as a back-up for nitrogen supply breakdowns and an alarm will alert the operator of nitrogen supply disruption.

Tanks and piping will be heat traced and insulated to prevent freezing due to the possible presence of water. Shut off of waste inlet valves at high level will be provided to prevent overfilling of tanks, fusible link shut-off valves will be installed at the bottom of the tanks, and flushing connections will also be provided.

All tanks will be of carbon steel, and of vertical cylindrical configuration with hopper bottoms.

System Sizing

The Waste Profile data and incineration plant operation were reviewed to arrive at the following basis for sizing the storage capacity of the incinerator tank farm:

- Organic waste deliveries will build up to 30 000 t/a for the initial 150 000 t/a capacity Facility.

- Joint discussions between Monenco, Environmental Elements Corporation, Von Roll Limited, and HIM and OWMC resulted in an agreement to size the tank farm to store six weeks (42 days) of pumpable waste inventory for the initial single incinerator installation. This provides ample storage in the event that a prolonged incinerator outage is necessary for maintenance. e.g. refractory repairs.

- No additional storage will be required should the second incinerator be installed, as it is anticipated that only one incinerator will be out of operation at any time.

- o The initial tank farm capacity will be based on estimates that 60% of the 30 000 t/a will be pumpable, requiring storage in the tank farm.

- o Space will be provided to increase the capacity of the tank farm in the future, if required, assuming 80% of the 30 000 t/a is pumpable.

- o Average density of the pumpable waste is assumed at 1 000 kg/m^3.

The above design basis for sizing, results in the following storage requirements for organic waste.

	t/a	m^3
Initial Installation:	18 000	2 589
Design Basis (for Space allocation only):	24 000	3 452

Note: Capacity is based on 7,000 hours of incineration plant operation each year (292 days). Hence, storage volume for initial installation is calculated as follows:

$$\text{Volume} = 18{,}000 \times \frac{1000}{1000} \times \frac{42}{292} = 2589\ m^3$$

Analysis of OWMC's waste data resulted in an allocation of this storage volume between the various waste categories, as follows:

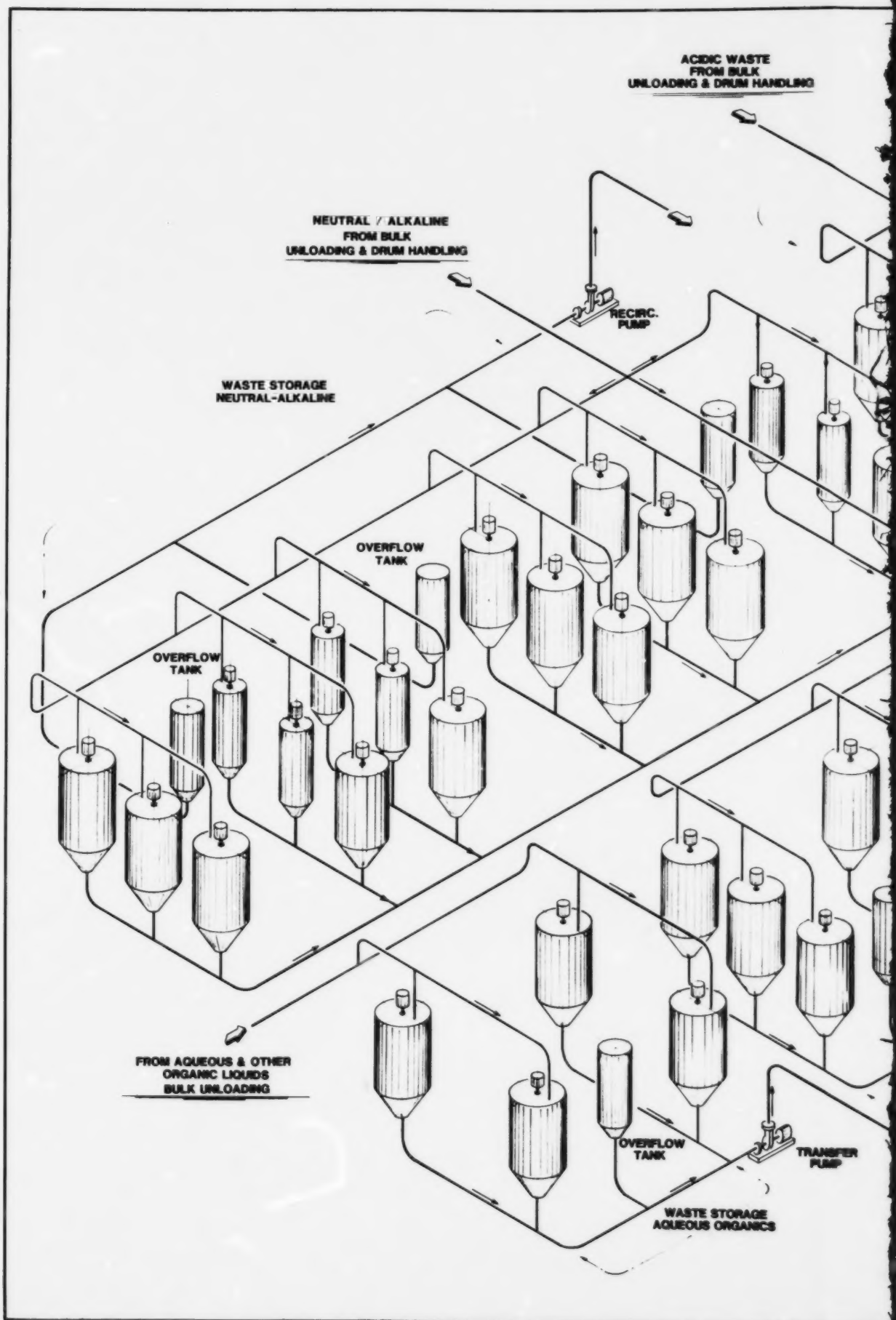
Tank Description	Initial Installation			Design Basis		
	Tank Size	No. of Tanks	Total Capacity	Tank Size	No. of Tanks	Total Capacity
Aqueous Organic	120 m^3	7	840 m^3	120 m^3	9	1 080 m^3
Waste Solvent	120 m^3	3	360 m^3	120 m^3	4	480 m^3
Waste Oil	120 m^3	3	360 m^3	120 m^3	4	480 m^3
Sludge	120 m^3	6	720 m^3	120 m^3	8	960 m^3
Halogenated Waste	10 m^3	3	30 m^3	10 m^3	4	40 m^3
Contingency	40 m^3	3	120 m^3	40 m^3	4	160 m^3
Blending - Liquids	60 m^3	2	120 m^3	60 m^3	2	120 m^3
Blending - Sludges	60 m^3	2	120 m^3	60 m^3	2	120 m^3
Totals		29	2 670 m^3		37	3 440 m^3

6.5.2 PHYSICAL/CHEMICAL STORAGE TANK AREA

The design of the physical/chemical tank storage system is shown diagramatically on Figure 16.

It is necessary, for safety and operability considerations, for the storage tank area to operate as an extension to the physical/chemical treatment plant, and all waste transfers to and from the storage tanks will be coordinated and supervised from the physical/chemical treatment plant control.

For aqueous organic wastes which will require pretreatment in the physical/chemical treatment plant, the transfers of waste to and from the physical/chemical storage will be coordinated by the operating personnel of physical/chemical and incineration plants who will liaise closely with each other and the waste scheduler.


ACIDIC WASTE
FROM BULK
UNLOADING & DRUM HANDLING
NEUTRAL / ALKALINE
FROM BULK
UNLOADING & DRUM HANDLING
RECIRC.
PUMP
WASTE STORAGE
NEUTRAL-ALKALINE
OVERFLOW
TANK
OVERFLOW
TANK
FROM AQUEOUS & OTHER
ORGANIC LIQUIDS
BULK UNLOADING
OVERFLOW
TANK
TRANSFER
PUMP
WASTE STORAGE
AQUEOUS ORGANICS

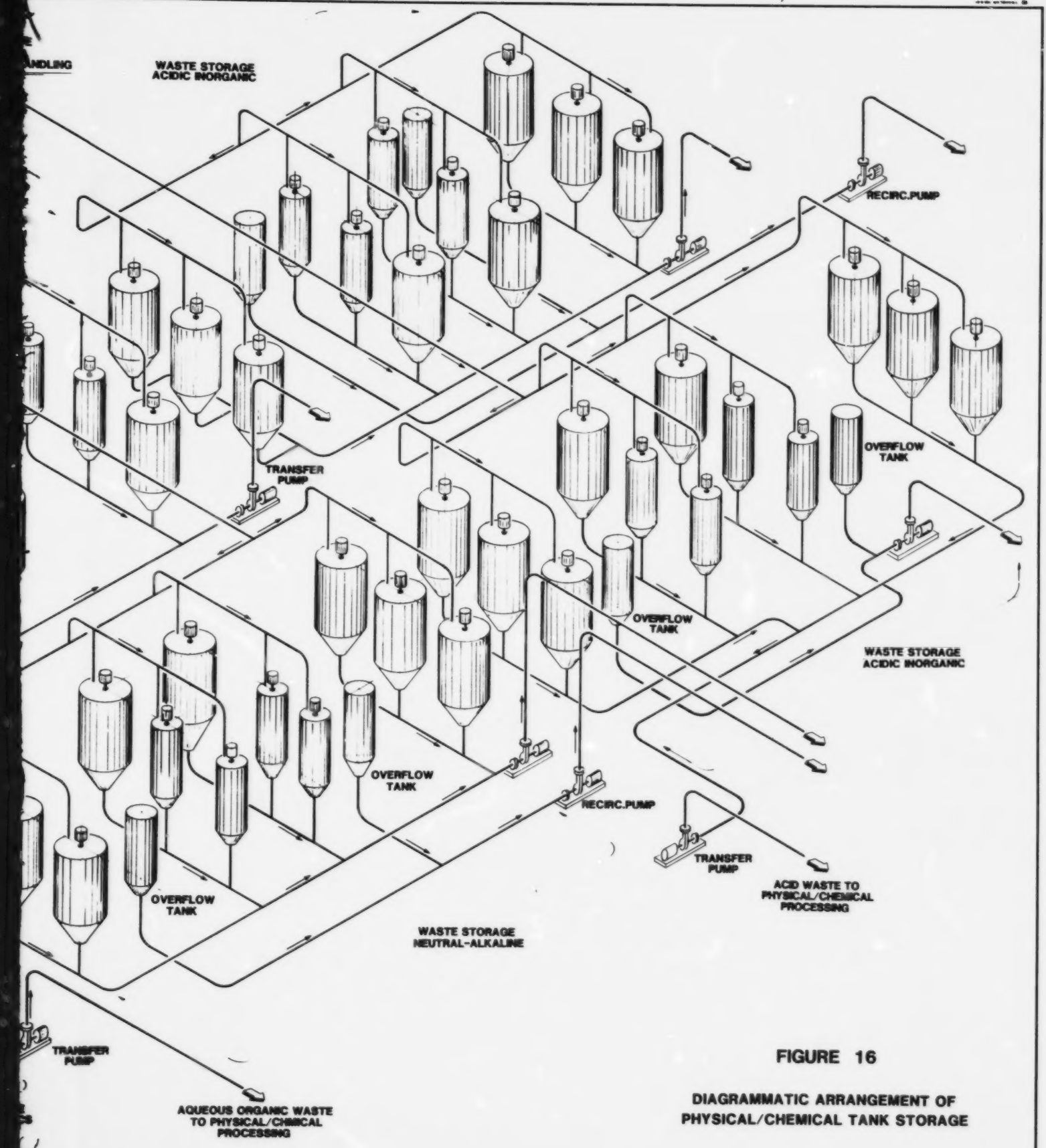


FIGURE 16

DIAGRAMMATIC ARRANGEMENT OF PHYSICAL/CHEMICAL TANK STORAGE

The waste storage tanks will be divided into the following groups:

- o Neutral/Alkaline
- o Acidic
- o Aqueous Organic

Each group of tanks will contain several small tanks rather than a few large tanks to enable further separation of waste on the basis of characteristics. Waste deliveries can be separated on arrival, through storage and treatment. Only after extensive testing to determine compatibility of storage and treatment, will different deliveries of wastes be mixed.

Important features of each storage tank grouping are described below:

Inorganic storage tanks (Neutral/Alkaline and Acidic)

The inorganic storage tanks will be grouped into modules of six tanks holding compatible wastes. Each module will consist of three 40 m^3 tanks, one 20 m^3 tank and two 10 m^3 tanks. The different sizes of tanks provides the flexibility to separate small batches of waste to facilitate optimum treatment of individual batches. Initially five modules will be designated for neutral/alkaline waste and four modules for acidic waste.

Feed to the inorganic storage tanks is from bulk unloading and wash liquid headers. In addition the neutral/alkaline tanks can receive slurry from the solidification plant. Remote operated valves will be provided for directing waste to the designated storage tank and the inlet valves will be closed at high levels to prevent overfilling of the tanks. The storage tanks will be equipped with breather valves for air intake.

Each six tank module will have a separate overflow tank to reduce the potential for cross contamination between tanks. The overflow tanks will be of 4 m^3 size, allowing approximately 5 minutes for operator intervention after activation of the high level alarm on a storage tank. The vent piping from individual storage tanks to the overflow tank of the group will prevent overflow from one tank into another within the tank module.

The tank configuration will permit the removal of solids, separation of the aqueous phase, and blending of the wastes. Mixing will be with agitators.

Six headers will be provided to transfer waste to the physical/chemical treatment plant. Two headers will be designated for acidic waste, two headers for neutral/alkaline waste, one header for aqueous organics - acidic and one header for aqueous organics - neutral/alkaline.

Waste will be transferred by pumps which will be remotely started/stopped, and remote operated valves will direct the wastes to the designated reactor in the physical/chemical treatment plant.

Flushing connections will be provided as the piping configuration requires, the piping being flushed into storage tanks or into the physical/chemical reactors. Wash liquids from the tanks will be sent to the physical/chemical treatment plant for treatment.

The vent gas from the tanks will be piped via the overflow tanks to a system that will remove contaminants before being discharged to atmosphere. Further details of all venting systems are provided in Chapter 12.

Aqueous Organic

Aqueous organic storage will consist of four tanks with a volume of 40 m^3 each. Provision of four tanks gives the flexibility to separate batches of waste to facilitate optimum treatment of individual batches. Feed to the storage tanks can be from bulk unloading, organic drum unloading, and wash liquid headers. Remote operated valves will direct the waste to the designated storage tank where mixing will be by agitators.

Closing of inlet valves at high levels will be provided to prevent overfilling of tanks and fusible link shut off valves will be installed at the bottom of the tanks which will close in the event of fire.

The four tanks will have a common overflow tank. To reduce the potential for cross contamination between tanks, the overflow tank will be of 4 m^3 size, allowing approximately 5 minutes for operator intervention after activation of the high level alarm of the tank. The vent piping from individual storage tanks to the overflow tank will prevent overflow from one tank into another.

A common transfer pump will be provided to transfer aqueous organic waste from any one of the four storage tanks plus the overflow tank. Remotely operated valves will be provided to direct waste to physical/chemical treatment or to incinerator tank farm, as required. The pump will be remotely started/stopped.

Flushing connections will be provided as determined by the piping configuration, the piping being flushed into storage tanks or into the physical/chemical reactors.

The aqueous organic storage tanks in the physical/chemical storage will be blanketted with nitrogen. The nitrogen will be introduced through a pressure valve installed in a common supply line and set to maintain a minimum pressure of about 14 kPa gauge. Vent gases from the tanks will be piped via the overflow tank to the incinerator tank farm vent system. The vent will combine with the incinerator vent system downstream of the common incinerator tank farm overflow tank. (Further details of all venting systems are provided in Chapter 12.)

The vent system will be provided with vacuum relief as a back up for nitrogen supply breakdowns. An alarm will alert the operator to a nitrogen supply disruption.

Auxiliary and Safety Systems

The layout will be developed to satisfy operability, fire, safety, and environmental protection requirements.

Storage tanks will be located in dyked areas to provide two levels of engineered containment, and as required by appropriate codes, as further addressed in Section 4.2.3 (p. 43).

Vent systems described in earlier paragraphs are further described in Chapter 12, and are specifically designed to minimize potential emissions to atmosphere.

The inorganic waste storage tanks and associated piping will be of reinforced plastic construction. Tanks will be vertical, cylindrical, conical bottomed and provided with sampling connections. The aqueous organic tanks and associated piping will be carbon steel, based on a preliminary evaluation of the materials of construction for the Facility.

System Sizing

The waste profile data and operation of the physical/chemical treatment plant were reviewed to arrive at the following basis for sizing the storage capacity for inorganic waste.

- The initial installation will be based on 100 000 t/a of pumpable inorganic waste.

- The storage tanks will be sized for four days of waste inventory based on:
  - one day storage volume for the incoming waste,
  - one day inventory ready for treatment,
  - one day inventory for testing purposes to verify the appropriate treatment method, and
  - one day inventory to account for shipments to be stored for longer periods, for batches of on-site generated wastes pumped in intermittently, and for partially full tanks due to smaller shipments requiring separation.

- Average density for pumpable inorganic waste is assumed at 1 000 kg/m^3.

- Space will be provided to double the tank storage area in the future, if required.

The above basis for sizing results in the following storage requirements for inorganic waste.

$$\text{Required Storage} = 100\,000 \times \frac{4}{250} \times \frac{1\,000}{1\,000} = 1\,600\ m^3$$

Note: The physical/chemical plant will operate 250 days per year.

Analysis of OWMC's waste data resulted in an allocation of this storage volume between the various waste categories as follows:

Inorganic Storage	Tank Size (m^3)	No. of tanks	Total Capacity (m^3)
Neutral/Alkaline	40	15	600
	20	5	100
	10	10	100
Acidic	40	12	480
	20	4	80
	10	8	80
Aqueous Organic	40	4	160
Totals		58	1 600

CHAPTER 7
DRUM HANDLING

7.1 INTRODUCTION

An analysis of OWMC's waste data indicates that approximately 1% of inorganic waste (1200 t/a) and 6.3% of organic waste (1 900 t/a) may be delivered in drums.

The purpose of the drum handling facilities is to provide for the unloading, sampling, storage and processing of wastes delivered to the Facility in drums, including:

- wet or dry solids,
- liquids, and
- pumpable sludges.

7.2 DESIGN CRITERIA

The criteria established for the design of drum handling facilities stipulate that:

- automatic systems are preferred to manual systems to minimize occupational health risks and operating costs,

- separate organic and inorganic facilities are to be provided for drums,

- o fork lift trucks shall be used wherever possible, to off-load consignments of drums,

- o drum holding areas are to be provided for sampling of drum contents, for verification testing, prior to placing drums in storage,

- o secure lock-up storage areas are required for certain wastes,

- o drum handling systems are required to facilitate emptying of drum contents and/or sending the drum with its contents for treatment.

7.3 ALTERNATIVES CONSIDERED

The following major alternatives were considered in the design of these facilities:

- o The extent of automation for organic and inorganic drum handling.

- o Fully enclosed or partially enclosed (roof only) installation.

The design of the drum handling facilities was developed based on:

- o recommendations and conceptual designs developed by OWMC's Incineration Technology Consultants (Environmental Elements Corporation, Von Roll Limited, and HIM) and by

- o gathering information from similar operating plants in Europe, and the U.S.A.

7.4 EVALUATION OF ALTERNATIVES

The extent of automation for organic and inorganic drum handling facilities was determined having consideration to the quantity of waste and the type of container expected, together with experience obtained from operating installations. The main considerations were safety, operability and cost.

Fully automatic drum handling systems are not practical for application to hazardous waste treatment facilities, due to the variability in waste, the difficulties caused by damaged drums and the variations in drum sizes. However, it is realized that manual operations are to be avoided where practical to enhance occupational safety and increase efficiency.

Where manual operations do occur ventilation will be designed to protect the environment.

7.4.1 ORGANIC DRUM HANDLING

A semi-automaic system that combines automatic and manual handling has been adopted for the drums containing organic wastes on the following basis:

- Most organic waste is expected to be delivered in standard 200 litre drums. These drums when undamaged lend themselves to being conveyed and handled automatically. Conveyors and handling equipment will be under the direct supervision of operators.

- Drums are fed to the incinerator on a continuous (24 hours) basis. An automatic conveyor system can achieve this with the minimum operating staff, in a safe and economic manner.

7.4.2 INORGANIC DRUM HANDLING

A semi-automatic system was considered, however it was deemed impractical due to the large variety of types and sizes of containers expected.

It was considered appropriate to provide facilities for the systematic handling, storage, retrieval and emptying of containers using manual methods, supplemented by the use of mobile vehicles such as fork lift trucks wherever possible. Safety of operations, including occupational health, will be addressed by operating procedures and protective systems, including special clothing, where necessary.

7.4.3 BUILDING ENCLOSURES

Consideration was given to housing the drum storage area and handling facilities within an area provided with a roof with open sides to permit the maximum natural ventilation for the operating area. This design is common to operating plants in Europe.

OWMC's drum handling facilities will be enclosed for the following reasons:

- If outdoors, the frost damage to drums of aqueous waste would result in leaks and spills.

- The indoor environment can be heated to provide a comfortable working environment for employees, together with improved occupational safety in the work place.

- Enclosure and ventilation of the drum handling facilities will control fugitive emissions and permit ventilation air to be cleaned (by process scrubbing) and the contaminants removed prior to the air being discharged to the atmosphere. This is clearly beneficial to the environment compared with open/outdoor installations.

7.5 DESIGN AND OPERATION

This section addresses the design and operational considerations of drum handling facilities. The organic drum handling and inorganic drum handling facilities are dealt with separately in sections 7.5.1 and 7.5.2, respectively.

7.5.1 ORGANIC DRUM HANDLING

Figure 17 is a diagrammatic illustration of the organic drum handling facility.

Vehicles carrying drums of organic waste will be directed to the organic drum storage and handling building for unloading after clearing routine reception procedures, including weigh-in and checking of the manifest papers at the Facility gatehouse.

After the truck is cleared for unloading it will be directed to the unloading bay which is designed to allow the simultaneous unloading of three trucks.

Forklift trucks used to unload the drums from the trucks will be designed to handle both single drums as well as drums on pallets. During the unloading process, all drums will be checked and, if leaking, it will be placed into a larger drum immediately. To facilitate truck unloading, the floor of the facility will be elevated 1.2 meters above grade. An access ramp will be provided to allow movement of forklift trucks into and out of the drum handling facility.

Once unloaded, the drums will be placed in a reception area assigned for them. The drums will be checked against the shipping list and necessary samples will be taken by the laboratory for verification of the contents. Once the inventory and content are confirmed to be in agreement with the shipping authorization papers, drums will be transported to one of the following:

- storage area,
- special lock-up waste storage area, or
- directly to the loading conveyor.

Any drums which fail the verification fingerprint test, will be rechecked and if necessary, the waste generator will be contacted to discuss the discrepancies and to resolve the matter.

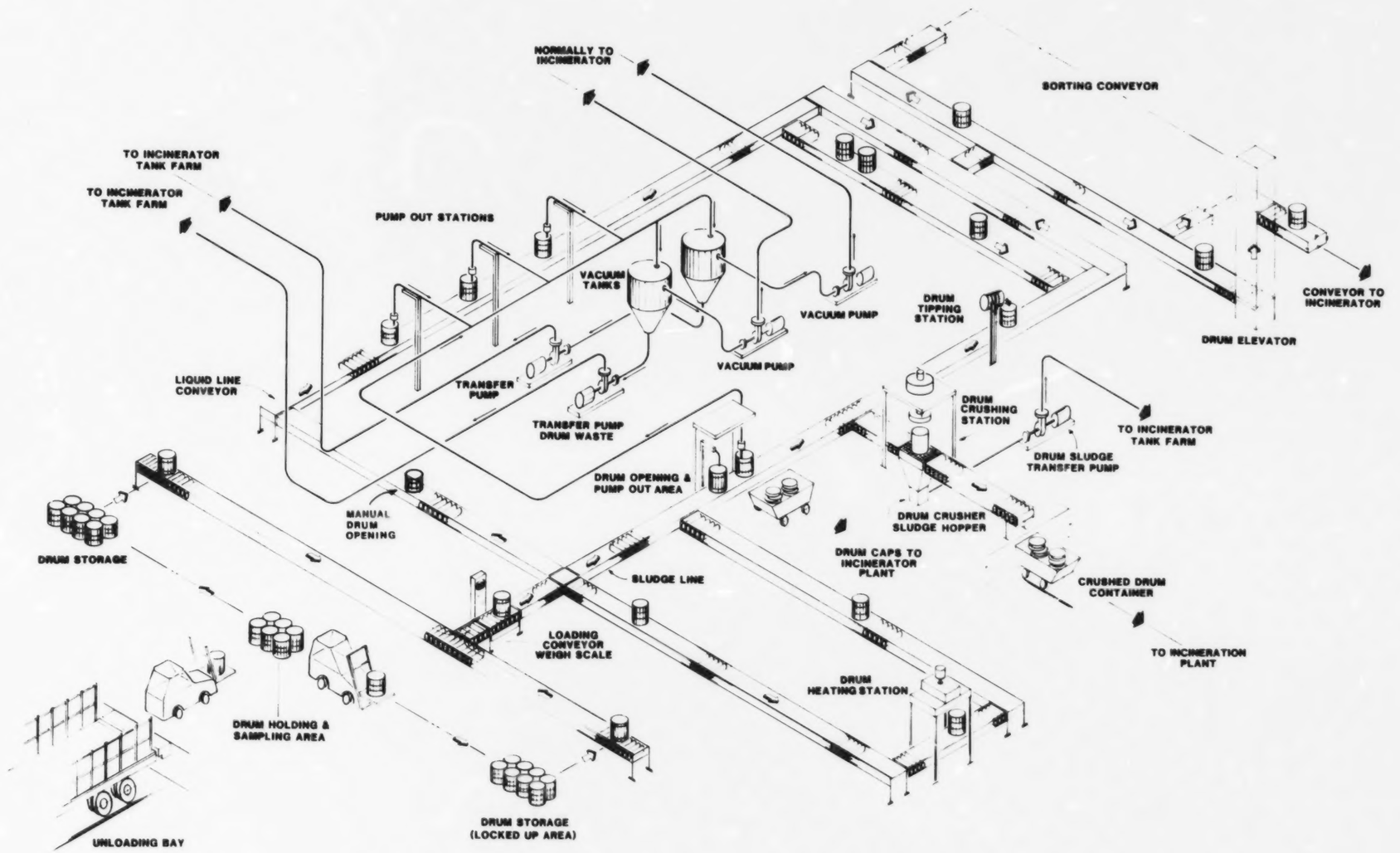


FIGURE 17

DIAGRAMMATIC ARRANGEMENT OF ORGANIC DRUM HANDLING

Storage Areas

Drums will usually be sent to pre-assigned storage areas. By storing drums in accordance with the physical state of their contents treatment operations can be selected more effectively and drums can be taken out of the storage areas in accordance with the treatment schedule. Drum storage capacity will be provided for 2 000 drums on the assumption that half the quantity of drums can be double stacked.

A designated area with lock-up facility for 200 drums will be provided for wastes which need special security arrangements; these drums are included in the total storage capacity of 2 000 drums.

Drums will be transported from storage to the loading conveyor by forklift truck. The drum caps or removable tops will be opened prior to being processed. The release of fugitive emissions from opened drums will be minimized by covering the top of the drums while they are in transit in the drum handling facility. Spark free equipment will be provided to cut small pump-out holes in drum tops, if required. The drums will then be directed automatically to their preselected handling line. On route, the drums will have their weight recorded by an in-line weigh scale.

Drums will usually be processed in batches of a given waste type, to avoid mixing of wastes which may, for example, polymerize and block pump-out lines or storage tanks.

Liquid Line

Drums containing liquids will be conveyed to the drum pump-out station. Three suction arms connected to vacuum tanks will be provided to remove liquids. Two vacuum tanks will be provided for collection of the pumpable wastes with one tank being used for aqueous waste, the other for liquids. Once a tank is filled, the contents will be pumped to the appropriate tank in the incinerator tank farm.

Drums that cannot be emptied because of sludge or solid residue will be transported to the drum opening station where they will be prepared for incineration.

Empty drums will be conveyed to the drum sorting conveyor where they will be held, pending transfer to the incinerator by conveyor.

Sludge Line

Drums containing sludge or solid waste will be conveyed to the drum opening station where drums which do not have manually removable tops will have the drum top removed automatically by a spark free cutting tool. A handheld power assisted drum opener will be used for out-of-shape drums.

The cut drum tops will be removed from the drum manually and placed in a covered container which will be transported to the solid waste pit of the incineration plant. A total of about 12 drums per hour can be opened under normal conditions.

Once opened, the drums will be inspected visually. A suction arm connected to the vacuum tanks will be provided to remove liquids which may have accumulated on top of the solid waste or sludge. These liquids will be transferred to one of the vacuum tanks assigned to the drum pumpout station.

Drums of non-pumpable sludge will be conveyed to the drum crusher. The operation of the drum crusher will be pushbutton controlled, with each drum being gripped by a clamp and placed on a grid with the open end downward. A hydraulically operated ram will crush the drum, pressing the waste through a grid into a sludge hopper located underneath. Crushed drums will be collected in a covered container which will be periodically emptied into the incineration plant solid waste pit. Sludge removed from the drums will be pumped directly to the sludge tanks in the incinerator tank farm. Approximately 12 drums per hour can be crushed.

Drums containing solid waste will be conveyed to the drum sorting conveyor where they will be held, pending transfer to the incinerator by conveyor.

Drum Heating and Tipping

The drum handling system includes features to deal with highly combustible solids or highly viscous material which might cause excessive heat release in the incinerator if fed directly to the incinerator.

Highly viscous or wax-like materials conveyed to the drum heating station where, depending on the material and the amount present in the drum, the heating process will take two to eight hours. The heating process will render the contents of the drums less viscous and allow it to flow. The heating station will have two independent sections with separate conveyors and doors, each section being capable of heating eight drums simultaneously. The temperature will be selected by the operator based on instructions on the waste data sheet. Prior to heating each drum will be vented. Vapours from the heating process will be collected and vented to the emission control system.

After heating, drums will be conveyed to the drum opening station in the liquid line where the tops will be removed. Drums will then continue to the tipping station where a predetermined portion of the drum contents will be tipped into one or more empty drums under manual supervision. Once tipped, the drums will be covered to prevent fugitive emissions and conveyed to the drum sorting conveyor.

Operation of the drum heating station is expected to be infrequent, based on experience in European installations. A more usual requirement is for the contents of a drum containing non-pumpable sludge or solid material, to be divided between two or more drums. In this event, the drum would be opened and conveyed directly to the drum tipping station where the drum contents can be divided between drums.

The drum tipping station will also be used to divide the contents of a drum containing certain liquids, such as paint pigments, which are difficult to pump and have high heat content.

The drum heating and tipping facilities provide the flexibility required to process drums of organic wastes in a safe, efficient manner, prior to incineration.

Drum Sorting Conveying System

Under most circumstances, the drum handling facility is expected to operate only one shift each day, five days a week. Hence, a buffer storage is required to enable drums of pre-prepared waste to be fed to the incinerator on a continuous basis. The drum sorting conveyor system provides this flexibility together with the ability to predetermine the feeding sequence of drums to the incinerator.

An array of 7 conveyors, each with a storage capacity of 58 drums, will be provided. Drums of waste having the same or similar characteristics will be stored on the same conveyor, and some conveyor(s) may contain empty drums ready for disposal by incineration.

A shuttle conveyor will reclaim drums from the sorting conveyors in a predetermined sequence which will be established by the incineration plant operator in accordance with the daily feed menu. A typical sequence may include a drum of wet sludge, followed by high heating value paint pigments, interspersed by empty drums. The importance of this capability to incineration plant operation, is described in the Process Area Report - Incineration (Ref: Monenco Limited[6]).

Auxiliary and Safety Systems

All floor areas of the drum handling facility will be sloped to floor drains leading to sumps. The system of containment will be in accordance with Section 4.2 p. 42 of this report.

The fire protection system in this building is covered in Section 4.3 p. 49.

Building ventilation is an important aspect of the design, as previously discussed in Section 7.4.3 p. 116. The building will have two levels of ventilation, the storage areas which have a normal level of ventilation, and the drum sampling and active processing areas which require a higher level of ventilation to ensure personnel safety.

Active work stations, and areas of conveyors which will convey open drums, will have ventilation suction hoods located above them to contain fugitive emissions. In addition, the active processing areas will be highly ventilated, to minimize occupational risks due to exposure to volatile organics. All air exhausts will be routed to an emission control system which will remove organics prior to the air being released to the atmosphere.

Further details of the venting system are included in Chapter 12.

System Sizing

OWMC waste data was analysed by Environmental Elements Corporation/Von Roll Ltd. to determine the required capacity of the organic drum handling facility. A considerable variation in the quantity of drums is expected and the sizing philosophy therefore includes:

- the initial installation will be based on low drum waste scenario and 8 hour per day operation,
- an increase in capacity can be made by increasing the number of unit work stations, and
- further capacity can be obtained by increasing the hours of operation, up to 24 hours per day.

The initial design is based on the following:

- 8 hours per day, 250 d/a or 2 000 h/a.
- Estimated quantity of waste in drum is 6.3% of 30 000 t/a, or 1 900 t/a.
- Design basis assumed 15% of 30 000 t/a is delivered in drums, or 4 500 t/a. (22 500 drums per year assuming 200 L drums)

For design purposes, the equipment will be sized to initially handle the following low drum waste scenario which is:

	Percent of total	Requirement t/a	Design t/a	Design Drums/h
Solids	33.3	633	1 500	3.9
Sludges	44.5	845	2 000	5.0
Aqueous Liquids	4.4	84	200	0.5
Organic Liquids	17.8	338	800	2.0
Total	100.0	1900	4 500	11.4
				(91 drums per day)

By operating 24 hours/day, 250 days/a or 6,000 hours/a, the organic drum handling facility can handle three times as many drums per annum (13,500 t/a), with some variation in the proportion between different forms of organic wastes. This flexibility can therefore accommodate the requirement of the high drum waste scenerio which indicates the organic drum waste could be as much as 11,080 t/a:

In order to accommodate expansion of the organic drum handling facility to 60,000 t/a incineration throughput, space has been allocated to incorporate the following equipment into the active process area:

- a second drum opening station
- a second drum crushing station
- a second set of pump-out stations (three suction arms)

Additional equipment is assumed to be similar to that already described. In addition, space has been allowed for the expansion of the building for the additional drum storage space and sorting conveyor space that would be required for a larger capacity facility, should this be required in the future.

The conveyor system installed initially, would still be adequate if the facility were expanded to 60,000 t/a incineration throughput.

7.5.2 INORGANIC DRUM HANDLING

Figure 18 is a diagrammatic illustration of the inorganic drum handling facility located adjacent to the inorganic bulk unloading stations.

In this section, the word drums is used synonymously with containers since much of the waste will be delivered in containers of varying size and type.

Vehicles carrying drums of inorganic waste will be directed to the inorganic drum storage and handling building for unloading after clearing reception procedures.

After the truck has been cleared for unloading it will be directed to the unloading bay which will be designed to allow the simultaneous unloading of three trucks.

Forklift trucks will be used to unload the drums from the trucks and will be designed to handle both single drums as well as drums on pallets. During the unloading process, all drums will be checked, and, if leaking, it will be placed into a larger drum immediately. To facilitate truck unloading the floor of the building will be elevated 1.2 meters above grade. An access ramp will be provided to allow movement of forklift trucks into and out of the drum handling facility.

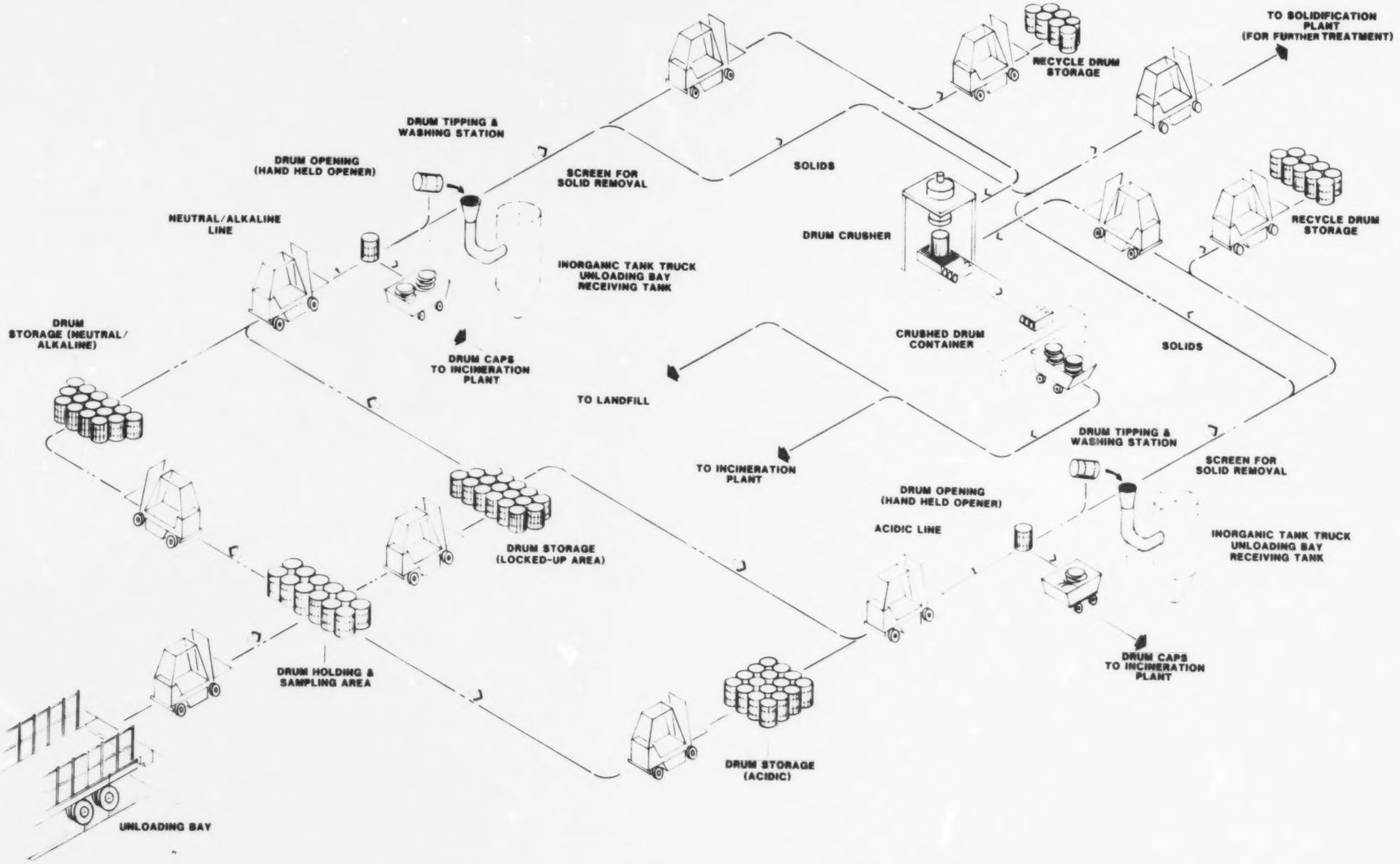


FIGURE 18

DIAGRAMMATIC ARRANGEMENT OF INORGANIC DRUM HANDLING

Once unloaded, the drums will be placed in a reception area assigned to them. The drums will be checked against the shipping list and necessary samples will be taken by the laboratory for verification of the contents. Once the inventory and content are confirmed to be in agreement with the shipping authorization papers, drums will be transported by forklift truck to one of the following:

- o neutral alkaline waste storage area,
- o acidic waste storage area,
- o special lock-up waste storage area,
- o directly to the emptying station, or
- o directly to the solidification plant for further treatment.

Any drums which fail the verification fingerprint test will be rechecked and if necessary the waste generator will be contacted to discuss discrepancies and to resolve the matter.

Storage Areas

Drums will usually be sent to pre-assigned storage areas where they will be stored along with waste having similar characteristics. Drum storage capacity is based on a one week holding capability of approximately 600 (200 litre) drums. A designated area with lock-up security for 100 drums will be provided for wastes which need special security arrangements, these 100 drums being included in the total storage capacity of 600 drums. The drum storage area sizing is based on no stacking of drums.

Drum Emptying

Drums will be transported from storage to the appropriate emptying station where they will be opened. A portable hand held opener will be provided for those drums that require the tops cut off although many may be plastic containers with screw caps. Space will be provided for additional drum/container opening equipment if required at a later date.

Once opened, the contents of each drum will be tipped through a screen into the unloading tank. High pressure wash water will then rinse the drum to dislodge any remaining waste. The wash water will also drain directly into the unloading tank. The operation of the tipping/rinsing station will

be semi-automatic with direct supervision of an operator. Each tipping station is capable of handling approximately twelve drums per hour. Smaller plastic containers will be emptied manually.

Four of the inorganic bulk waste unloading tanks will be equipped with receiving chutes and hoppers. The other five tanks will be provided with blanked connections for future expansion. The outside two unloading bays at each end (ie. stations No. 5, 6, 12 and 13) have been selected for the initial installation, thereby providing maximum flexibility in designating the service for the unloading stations. Waste and rinse water will be pumped to designated storage tanks in the physical/chemical storage tank area. (Chapter 6 p. 106).

Two of the unloading tanks will normally be used for acidic wastes and the other two for neutral/alkaline wastes.

Empty steel drums will be transported by forklift to the drum crusher or the storage area for recycled drums. Crushed drums and drum lids will be collected in a covered container and transported to the incineration plant waste pit. Drums will be crushed automatically in the drum crusher.

Solids retained on the screen will be transferred to an empty drum and transported to the solidification plant for treatment.

Auxiliary and Safety Systems

All floor areas of the drum handling facility will be sloped towards the floor drains which lead to sumps. The system of containment will be in accordance with Section 4.2 p. 42 of this report.

The fire protection system in this building is covered in Section 4.3 p. 49.

The building will have two levels of ventilation, the storage areas which require a normal level of ventilation, and the drum sampling and emptying areas which require higher level ventilation to ensure personnel safety. Fume suction hoods will also be provided over emptying stations.

All air exhaust will be cleaned by process scrubbing prior to being released to atmosphere.

Further details of vent systems are included in Chapter 12.

System Sizing

OWMC waste data was analysed to establish the capacity of the inorganic drum handling facility. The design is based on the following:

- Eight hours per day operation, 250 d/a or 2 000 h/a.
- Estimated quantity of waste is 1% of 120 000 t/a, or 1 200 t/a.
- Design basis assumes 4% of 120 000 t/a is delivered in drums, or 4 800 t/a. (24 000 drums per year assuming 200 litre drums)

The design basis has been selected to provide flexibility in accommodating fluctuations in the quantity of waste delivered in drums, and further capacity could be achieved if required, by operating additional hours.

For an eight hour per day operation 96 drums per day or 12 drums per hour can be processed.

Space has been allowed for expansion of the inorganic drum handling facility, should this be required in the future.

CHAPTER 8
LABORATORIES

8.1 INTRODUCTION AND PURPOSE

OWMC's on-site laboratory facilities will be used to determine the characteristics of wastes proposed for treatment and to establish guidelines for their shipment, receiving, sampling, unloading, storage and treatment at OWMC's Facility.

The laboratory facilities will also be used to conduct tests to ensure that treatment objectives are being achieved. A further purpose will be to provide analytical services which are related to worker health and safety and environmental monitoring program.

Since encouraging reduction, recovery, recycling, and reuse of wastes is part of OWMC's mandate, technical services and long-term development work related to the waste reduction program is also expected to be carried out in the laboratories.

The design of on-site laboratory facilities was developed by:

- gathering general information from similar operating treatment plants in Europe and the USA,
- obtaining specific information directly from Hessische Industriemüll GmbH (HIM), who operate laboratories associated with similar treatment facilities in West Germany, and
- experience of both OWMC and Monenco staff.

8.2 DESIGN CRITERIA

It was established that the following functions be undertaken by the laboratories and form the design criteria:

- o analysis and characterization of all waste prior to its acceptance by OWMC;

- o testing of individual waste samples to determine optimum treatment sequences, procedures, reagent needs, reaction times and other process parameters (i.e. treatability testing);

- o verification that wastes received for treatment are the same as the samples previously submitted for analysis, within prescribed limits (i.e. fingerprinting);

- o recommendation of worker safety procedures for sampling, testing, unloading and handling of wastes;

- o conducting process control analyses, to confirm that the treatment is proceeding as expected;

- o providing analytical services to environmental monitoring related to effluents and emissions discharged from the Facility;

- o providing analytical services to in-plant monitoring as part of an occupational health program;

- o providing technical services to Operations personnel in the daily operation of the plant;

- o providing technical services to OWMC's Marketing Department such as analytical services and assisting clients in development work related to waste reduction programs,

- o establishing quality control procedures for all analytical work;

Specific criteria established for design purposes require that:

- the laboratories be sized to support the treatment of 300 000 t/a of waste,

- the instrumentation and equipment installed initially must support the treatment of 150 000 t/a of waste,

- selected instrumentation should have the flexibility to accommodate a wide range of testing procedures,

- criteria for instrumentation selection should focus on flexibility and sensitivity for intended services, availability of maintenance services, durability and reasonable costs,

- laboratory design must prevent cross contamination of environmental in-plant monitoring samples by other samples,

- sophisticated and sensitive electronic instrumentation should be kept in rooms which are under positive pressure, controlled temperature and humidity,

- the methodologies and protocols employed in OWMC's laboratory facilities will be compatible with the nature and purpose of the tests,

- in general, methodologies and protocols will be consistent with those prescribed by ASTM, or the Ontario Ministry of the Environment or other regulatory bodies,

- a data base of waste information including characteristics, source, treatment procedures, performance, etc. will be maintained. The information will be updated and subject to refinement as a result of experience.

8.3 ALTERNATIVES CONSIDERED

Although the total analytical work load is defined by the functions identified in Section 8.2, the number of instruments will depend on where the analytical work will be carried out. The alternative concepts of centralized and dispersed laboratories were considered.

- The centralized laboratories concept is where the work requiring sophisticated instruments is carried out in the main laboratory located in the Administration Building with routine tests to be carried out in the physical/chemical treatment plant.

- The dispersed laboratories concept is where some analytical work will be carried out in the main laboratory and all analytical work related to the physical/chemical plant process control and treatability tests will be carried out in a separate laboratory located in the physical/chemical treatment plant.

The fundamental difference in these concepts is that the dispersed laboratories, will have duplication of some instruments, personnel and air conditioning systems. The centralized laboratories concept will reduce this duplication to a minimum.

8.4 EVALUATION OF ALTERNATIVES

Based on their experience in operating similar treatment facilities in West Germany, HIM recommends that the dispersed laboratories philosophy be adopted. This requires that a separate, fully-equipped laboratory be located in the physical/chemical treatment plant.

The main advantages of this arrangement are as follows:

- o Close cooperation will be achieved between the personnel of the physical/chemical treatment plant and the laboratory, which will govern the operation of the plant.

- o A fully-equipped laboratory located in the physical/chemical treatment plant can undertake the following operation related work:
  - process control analyses for physical/chemical processes,
  - treatability tests on inorganic wastes,
  - solidification tests to determine optimum formulations and for quality control.

- o This arrangement will facilitate the close relationship between laboratory staff and the operations. It will also ensure familiarity of laboratory staff with plant operations. In particular, laboratory technologists undertaking treatability testing will be familiar with full scale operation of the treatment plant.

Most of the remaining laboratory functions identified in Section 8.2 will be performed in the main laboratory located in the administration building, which is considered the optimum location from which the analytical services will be provided for the testing of waste samples prior to and at the time of consignment delivery for treatment.

A more in-depth review of the two alternatives described in Section 3.3 will be undertaken in future by assessing the overall merit based on factors such as safety, operability, quality control and cost effectiveness.

8.5 DESIGN AND OPERATION

This section addresses the design and operational considerations of OWMC's laboratory facilities, based on the dispersed laboratories concept. The laboratories will be required to carry out a wide range of functions in four distinct waste acceptance and treatment stages namely:

- o Pre-Shipment Authorization Stage
- o Delivery Stage
- o Treatment Stage
- o Post-Treatment Stage

and technical services assisting clients in development work related to waste reduction. These functions are further illustrated on Table 5.

The main laboratory and physical/chemical laboratory are dealt with separately below:

8.5.1 MAIN LABORATORY

The main laboratory and its staff will carry out functions which include:

- o analysis and characterization of all inorganic and organic waste prior to its acceptance by OWMC,
- o verification that the wastes received for treatment are the same as those previously submitted as samples for analysis, within prescribed limits, excepting drummed inorganic waste which may be analysed in the physical/chemical laboratory for reasons of efficiency arising from physical location,
- o recommendation of worker safety procedures for sampling, testing, unloading and handling the wastes,
- o provide analytical services to environmental monitoring program,
- o provide analytical services to monitor the worksite environment as part of an occupational health program,
- o provide input to reports for submission to regulatory authorities,
- o provide technical services to operations personnel in the daily operation of the plant, including support to incineration plant operations,
- o provide technical services to OWMC's Marketing Department such as analytical tests and development work related to waste reduction program, and
- o establish quality control procedures for all analytical work.

TABLE 5

LABORATORY FUNCTIONS AT STAGES OF WASTE ACCEPTANCE/TREATMENT

PRE-SHIPMENT AUTHORIZATION	DELIVERY	TREATMENT	POST-TREATMENT	FUNCTIONS IN WASTE REDUCTION PROGRAM
o analyze and characterize samples of waste for various parameters.	o sample and analyze waste consignments to verify characteristics (fingerprinting).	o conduct process control analyses for performance verification and monitoring.	o environmental monitoring, sampling and analysis.	o analyze and characterize samples of waste for various parameters.
o treatability test samples of waste to recommend treatment processes, procedures, reagents and other process parameters.	o conduct additional analytical or treatability tests as required.	o monitor working environment.	o input to reports to regulatory agencies.	o bench scale tests for potential processes for waste reduction and assist evaluation of the processes.
o recommend occupational health and safety measures.	o identify requirements for cleaning equipment and piping.	o update or modify treatment recommendations for future reference, if required.		
o establish guidelines for fingerprinting of waste upon delivery.	o confirm treatment procedures.			
	o assist to assign unloading and storage location.			

The main laboratory will comprise four interdependent sections as follows:

- o Sample Receiving Section
- o Characterization Section
- o Instrument Section
- o Environmental Monitoring Section.

The laboratory will also include office space for the laboratory staff, for marketing and technical services and facilities for chemical supplies storage.

Table 6 identifies major equipment proposed for each section of the main laboratory.

The reasons for separating the sections in the main laboratory are as follows:

- o The sample types will range from very dirty, toxic and odorous (waste samples) to clean air quality samples. Separation will lessen the likelihood of contamination of the cleaner samples.

- o Some of the instrumentation is very sophisticated and costly electronic equipment that requires specialized care and controlled conditions in order to achieve proper performance. This equipment will be located in an air conditioned room under positive pressure to eliminate the effects of corrosive and undesirable fumes.

Sample Receiving Section

This section will sample waste upon delivery to the Facility and prepare these samples for characterization or finger printing. Space will be available for short term storage of samples. All sample documentation will be performed by this section which will work closely with the characterization and instrument sections of the main laboratory.

TABLE 6

MAIN LABORATORY - MAJOR EQUIPMENT AND INSTRUMENTATION

TYPES OF INSTRUMENTS DESCRIPTION	PARAMETER MEASURED/PURPOSE CONCENTRATION LEVEL	CHARACTERIZATION SECTION	INSTRUMENT SECTION	ENVIRONMENTAL SECTION
Gas Chromatograph - Flame ionization detector	Organic quantification ppm range	*	* (Coupled with mass spectrometer)	--
- Electron capture detector		--		*
- Thermal conductivity detector		*	--	--
Mass Spectrometer	Organic identification and quantification/ppm range	--	*	--
Inductively Coupled Plasma Emission Spectrometer (ICP-ES)	Trace metals in solution/ppb range	--	*	--
Atomic Absorption Spectrophotometer	Trace metals in solution/ppm-ppb range	--	*	--
Calorimeter	Heating value	*	--	--
Total Organic Carbon Analyser	Organic carbon content of water/ppm range	--	--	*
Ion Chromatograph	Trace levels of anions in aqueous solution/ppm	--	--	*
High Temperature Analyser	Total carbon, hydrogen, nitrogen and sulfur content/ppm	*	--	--

TABLE 6 (Cont'd)

MAIN LABORATORY - MAJOR EQUIPMENT AND INSTRUMENTATION

TYPES OF INSTRUMENTS DESCRIPTION	PARAMETER MEASURED/PURPOSE CONCENTRATION LEVEL	CHARACTERIZATION SECTION	INSTRUMENT SECTION	ENVIRONMENTAL SECTION
Infrared Spectrophotometer	Organics identification and fingerprinting, oil/grease contents/ppm range	*	--	--
Long path length ultraviolet (UV) Spectrophotometer	Mercury in effluents/ppm range	--	--	*
Ultraviolet (UV)/Visible Spectrophotometer	For determination of certain anions and fingerprinting purposes/ppm range	*	--	--
pH Meter	pH in aqueous solution	*	--	--
Flash Point Apparatus	Flash point	*	--	--
Viscometer (Brookfield)	Viscosity	*	--	--
Noise Level Monitor	In plant noise levels	--	--	*
Air Sampling Pumps	Sampling of dust and organic vapours	--	--	*
Fume Hood Standard Bench Top	--	*	*	*
Centrifuge	Phase separations	*	--	--

NOTE: * Denotes location of equipment/instrumentation in the relevant section.

Characterization Section

This section will characterize the organic and inorganic waste for treatment purposes, mostly prior to its delivery. It will work together with the main laboratory instrument section to analyse the sample for certain critical parameters such as heating value, density, solids content, cyanide, sulfur and chlorine content. If required, it will then transfer the waste sample to the physical/chemical laboratory where treatability and leachability tests will be carried out. It will recommend fingerprinting measurements to verify that the material delivered at a later date for treatment, is similar to the one characterized earlier, within prescribed limits.

Instructions will be provided for unloading and storage of each waste consignment including specific unloading stations and storage tanks, which will be determined in conjunction with Operations. Requirements for cleaning equipment after use will also be given.

This section will also provide analytical services and carry out development work related to waste reduction program, working together with other sections of the laboratories. Space will be allowed for specialized equipment for bench scale tests or pilot studies.

Instrument Section

The analytical instrumentation located in this section will be primarily the specialized equipment that requires highly trained personnel for proper operation, data interpretation and instrument maintenance. Chemical experiments will not be conducted here. The quantity of sample and site fugitive emissions entering the room will be minimized by operating procedures and by appropriately designed ventilation systems.

Environmental Monitoring Section

This section will carry out the necessary analytical work to ensure that the workplace and the surrounding environment are properly monitored. It will be primarily concerned with the measurement of low levels of inorganic and organic contaminants in the environment. This section will be separate from the others in order to avoid contamination of samples and it will work

closely with the instrument section for certain analyses. Trace elements in dust and identification and quantification of organic compounds in final treatment effluents are some analyses that are notable. Noise and safety procedures in the work place will also be responsibility of this section.

8.5.2 PHYSICAL/CHEMICAL LABORATORY

The physical/chemical laboratory will be located in the physical/chemical treatment plant, its specific location in that building being addressed in the Process Area Report - Physical/Chemical Treatment (Ref: Monenco Limited[7]). The laboratory will comprise three sections as follows:

- Process Control Section
- Instrument Section
- Solidification Section.

Table 7 identifies major equipment proposed for each section of the physical/chemical laboratory.

The reasons for separating sections in the physical/chemical laboratory are similar to those previously identified for the main laboratory.

- The sample types will range from very dirty, toxic and odorous to relatively clean leached water samples. In addition, the solidification laboratory will have a tendency to be dusty. Separation of the three sections will avoid transport of these contaminants.

- The instrument section will house very sophisticated and costly electronic equipment that requires specialized care and controlled and clean air conditions in order to achieve proper performance. This section will be air conditioned and under positive air pressure to eliminate the effects of dust and corrosive fumes.

The physical/chemical laboratory and its staff will carry out functions which include:

TABLE 7

PHYSICAL/CHEMICAL LABORATORY - MAJOR EQUIPMENT AND INSTRUMENTATION

TYPES OF INSTRUMENTS DESCRIPTION	PARAMETER MEASURED/PURPOSE CONCENTRATION LEVEL	PROCESS CONTROL SECTION	SOLIDIFICATION SECTION	INSTRUMENTATION SECTION
Inductively Coupled Plasma Emission Spectrometer	Trace metals in aqueous solution/ppm-ppb range	--	--	*
Total Organic Carbon Analyser	Organic carbon content of water/ppm range	*	--	--
Ion Chromatograph	Trace levels of anions in aqueous solutions/ppm	--	--	*
Infrared Spectrophotometer	Oil/grease contents of aqueous solution	*	--	--
Long Path Length Ultraviolet (UV) Spectrophotometer	Mercury in process effluents/ppm range	*	--	--
pH Meter	pH in aqueous solution	*	*	--
Walk-in Fume Hood - Standard Bench Top	--	*	*	--
Unconfined Compressive Strength Tester	For testing strength of solidified waste - test mould	--	*	--
Triaxial Cell and Accompanying Gauges	For testing permeability of solidified waste test mould	--	*	--

NOTE: * Denotes location of equipment/instrumentation in the relevant section.

- o treatability tests on inorganic wastes to determine optimum treatment sequences, procedures, reagent needs and other process parameters,

- o verification tests (fingerprinting) of inorganic wastes delivered in drums, if required,

- o process control analyses, to confirm that the treatment is proceeding as expected,

- o establishing optimum solidification formulations for the solidification process, and

- o conducting physical and chemical (leachability) tests on samples of solidified material for quality control purposes.

Process Control Section

The responsibilities of this section will be as follows:

- o Bench scale treatability tests on inorganic waste received at the pre-shipment authorization stage. It will recommend treatment sequences, procedures, reagent requirements and other process requirements necessary for each inorganic waste type. Tests such as jar testing of coagulant aids and bench scale reverse osmosis testing will be conducted here.

- o Wet chemical tests necessary for process control. Support from the physical/chemical instrumentation section will be required for certain instrumental analysis such as ICP-ES and ion chromatography. The results will also become the basis for refining the treatment procedures or recipes in the data base.

- o Verification testing on inorganic wastes delivered to the site in drum containers.

- o Assist calibration and maintenance of on-line process control measuring devices.

Instrumentation Section

This section will be equipped with specialized instrumentation to measure trace and major levels of cations and anions in solution. It will provide support to the process control section and solidification section. Chemical experiments will not be carried out here. The quantity of sample and site fugitive emissions entering the room will be minimized by operating procedures and the design of ventilation systems.

Solidification Section

The responsibility of this section will be to optimize solidification formulations and to test samples of solidified materials for quality control purposes.

Tests include physical testing of test moulds for parameters such as unconfined compressive strength and permeability in addition to chemical tests of the test moulds for its leachability characteristics. Leachates from these tests will be submitted to other physical/chemical laboratory sections for determination of major and trace levels of cations and anions. Trace organic levels in the leachates will be determined by the main laboratory - instrumentation section.

CHAPTER 9
DATA MANAGEMENT SYSTEM AND PROCESS CONTROL

9.1 INTRODUCTION

This chapter deals with two subjects directly related to the safety, security, and efficiency of operations at OWMC's Treatment Facility, namely:

- o data management system for safe, efficient planning, coordination and management of the overall operations of the Facility, and
- o process control system for the control and monitoring of the treatment processes and related safety systems.

Each of the following sub-sections examines the purpose of the systems, alternatives considered, evaluation of alternatives, and the design and optimization of the preferred system.

9.2 DATA MANAGEMENT SYSTEM

9.2.1 PURPOSE

The purpose of the data management system (DMS) is to provide an interactive, integrated information/data handling capability for efficient planning, co-ordination and management of the operations of the Facility. These operations will encompass the major facets of the Facility and include the following:

- o Materials flow - reception, handling and storage.
- o Data flow - acquisition, processing and storage.
- o Co-ordination and planning of individual processes, operations and administrative functions.
- o Updating, maintenance and storage of all required files and records.
- o Maintenance of a common integrated data-base to serve all users.
- o Generation of reports.
- o Historical storage and fast retrieval capability of important information/data.

The DMS will thus make available an audit trail for checking that operating, regulatory, and safety procedures are being followed.

9.2.2 ALTERNATIVES CONSIDERED

To determine the data management system concept three alternatives were considered:-

- o One system for both data management and process control. All data management and process control functions would be carried out by the one system using either a centralized or decentralized configuration.
- o A centralized data management system. This would provide a common data base, but entry, retrieval and manipulation of data would be performed essentially at one location as a batch operation, probably by specialist personnel, with resulting slow user interaction time.

- o A decentralized data management system. This would allow access to multiple data bases, with data entry, retrieval and manipulation by each user for his own limited application. This would provide quick interaction but with limited availability of data.

9.2.3 EVALUATION OF ALTERNATIVES

The use of one system for both process control and data management was eliminated because the different user and software requirements of the two systems make a combined system impractical. However, limited data communication between the two systems is required, and this will be provided.

The proposed DMS is based upon a conceptual blend of the centralized and decentralized approach, offering the following principle advantages of both:

- o The centralized approach (using a central computer in the data management centre) will provide an integrated common data base with an effective control over operation and maintenance of the DMS, its processing power, hardware and software, information/data exchange protocols and data security during exchanges and storage.

- o The decentralized approach, using distributed intelligent terminals, will enable individual DMS users to access the common DMS facilities readily in an easy, inter-active mode, via the DMS terminals situated in their respective area of operation. The DMS terminals will include capability for data entry, retrieval, visual display and hardcopy print-out.

The proposed system was considered to best meet OWMC's objectives, since it provides a high degree of peformance, safety and flexibility in operations throughout the Facility, as a result of high processing power and ready user access to information, without compromising security of operations.

9.2.4 DESIGN AND OPERATION

The data management system (DMS) will be an application oriented, computer based system with all the necessary peripherals and auxiliary equipment. The system hardware and software will be selected for flexibility, versatility and modularity to meet the requirements of the Facility along with ease of operation and maintenance. It will be based upon proven techniques and technology to offer high reliability and availability at a reasonable cost. Some of the essential characteristics of the DMS will include:

- o common, integrated data base accessible to all authorized users,
- o multi-tasking capability to enable simultaneous usage by a number of users without degradation of service, quality and throughput,
- o physical and access security of data within the DMS data-base during input/output, updates, transactions and storage,
- o ability to assign, control, prioritize and limit access from any DMS terminal, and
- o historical storage and retrieval capability.

The data management system will comprise the following components:

- o Common, central DMS equipment and facilities located at the data management centre in the administration building.
- o Local data communications network.
- o Data management system terminals located at designated areas within the Facility.

The areas designated for terminal access will be determined in accordance with the Facility Operating Procedures. It is anticipated there will be a maximum of twelve terminals.

The main users or functions to be served by the DMS are tabulated below in two broad categories called Administration and Process.

USER/FUNCTION CATEGORY

ADMINISTRATION	PROCESS
Accounting	Gate House
Personnel	Physical/Chemical Control Laboratory
Stores/Inventory	Scheduler
Procurement	Incinerator Process
Maintenance	Physical/Chemical Process
Sales/Marketing	Solidification Process
Analytical Laboratory	Landfill
Sampling Laboratory	Emission/Effluent Monitoring
Management Accounting	Central/Inter-Battery
Suppliers' Data	Utility Usage
Regulatory Data	Operations Management Data
Correspondence Log	Transfer Stations (later)
Technical Publications	
Waste Transportation	
Engineering Services	

9.3 PROCESS CONTROL

9.3.1 PURPOSE

The purpose of process control in the Facility is to provide control and monitoring for the waste treatment process areas, common site services and facilities, and safety systems.

The process control system will be provided to carry out these functions, and to provide an interface between the process operators and the plant equipment to allow the Facility to operate in accordance with the Operating Plan.

9.3.2 ALTERNATIVES CONSIDERED

Alternatives were considered both for the location of the operator interface with the process control system, and for the type of process control system equipment itself.

Operator Interface Location

Consideration was given to providing operator facilities to carry out process control functions in a number of different locations:

- Locally - adjacent to the individual plant equipment items
- Local Control Panels - panels located on the plant but with controls for adjacent equipment and/or processes grouped to assist local operators.
- More than one control room - rooms located in major process areas, from which all operator action and process monitoring for the respective area would take place.
- One central control room for the whole Facility - from this room all operator action and process monitoring would take place.
- A combination of the above.

Process Control System Equipment

Historically, there has been a progression of process control hardware technology for performing the process control functions required for the Facility. This technology includes:

- pneumatic, electronic analog, and electronic digital continuous and batch control and monitoring,

- o relay, solid state, and electronic digital control and monitoring of plant rotating equipment,

- o control panels containing controllers, indicators, annunciators, lamps and pushbuttons for operator information and action, and CRT/keyboard operator consoles in single or multiple arrangement containing the same information, and

- o data acquisition and storage equipment.

These alternatives were considered singly or in combination, for the particular requirements of the Facility.

9.3.3 EVALUATION OF ALTERNATIVES

The evaluation of alternatives focused on criteria relating to performance in terms of process and operator efficiency, personnel and plant safety, flexibility of operations and reliability of operation, which is fundamental to the safe performance of process operations.

Operator Interface Location

Two control rooms were selected, one in the incineration plant and one in the physical/chemical treatment plant, for the following main reasons:

- o The Facility consists of two distinct operating areas, namely organic treatment involving a continuous incineration process, and inorganic treatment involving batch operations.

- o Besides being largely independent from a process/operations perspective, the organic and inorganic operations are physically separated.

Overall, it was considered that OWMC's objectives in terms of performance, safety, flexibility and reliability of operations could be best achieved by two separate control rooms as described above.

Operator interface with the plant is centred in these two control rooms for proper coordination and safe and efficient operation of the respective process areas. The following features were selected in keeping with OWMC's Corporate goals pertaining to safety.

- o The size and complexity of the Facility requires a high degree of coordination in the receipt and transfer of waste throughout the Facility. For safety reasons, all waste transfers will be coordinated from the respective control rooms based on data available to operators directly from the DMS and process control system.

- o Certain plant operations, including waste unloading, physical/chemical plant reactors and emulsion breakers require local supervision for safety of operation, and local control will be provided for this purpose.

Process Control System Equipment

Modern electronic digital equipment will be employed to carry out all process control and monitoring functions, except for a few specialized local operations and cathode ray tube (CRT) interface will be provided in the control rooms. This equipment is based on microprocessor technology.

The major benefits of this approach compared with other alternatives, are summarized as follows:

- o Flexibility of programmable system to:
  - accommodate particular requirements of the process,
  - accommodate plant expansion with minimum cost, and
  - shorten design and start-up times.

- o Process monitoring capability provides:
  - the only system capable of organized process data collection and storage at reasonable cost,
  - increased availability of data for operators improves operating efficiency,

- provides data for plant management and record keeping, and
- can provide waste treatment audit trail.

o Communication capability includes:
- data communication with Data Management System, and
- data communication between control centres themselves.

o Current Technology, since:
- manufacturers of control systems and of mechanical equipment packages now supply digital controls in preference to other types which for many applications are now outmoded, and
- it is OWMC's stated intention to build a state of the art plant.

o Control Equipment Standardization results in:
- reduced operating and maintenance costs, and
- standard operator interface minimizes operator error (safety).

9.3.4 DESIGN AND OPERATION

Process control functions for the major processes will be coordinated from two control centres, one located in the incinerator area and one in the physical/chemical area.

The incinerator control centre will be the principal control centre for the Facility, as it will be manned continuously on a 24 hours/day - 7 days/week basis. The physical/chemical control centre will be manned during operating hours - 5 days/week basis. This results from the different operating requirements of the respective processes.

Common process systems, utilities and plant wide safety systems will be controlled and monitored from the incinerator control centre.

Other area control rooms and/or control panels will be situated in areas dictated by operating procedures.

The process control system will consist of the process control, monitoring and the operator interface equipment required in the two control centres, together with the equipment located in the minor operating areas as determined during detailed design.

Limited data storage capability will be available in the process control system as dictated by the operational requirements of each individual process.

Modern digital technology will be employed for the process control system. Maximum use will be made of operator interface via CRT and digital communication techniques to improve data access and storage and to reduce plant cabling.

Equipment for the process control systems will be selected according to the functions identified and quantified during the design phase of the project. The number of equipment vendors will be kept to a minimum, consistent with functions to be performed and the availability of proven cost-effective equipment.

CHAPTER 10
ELECTRICAL SYSTEMS AND COMMUNICATIONS

10.1 INTRODUCTION

This chapter addresses the distribution of electricity around the site, as well as associated lighting, communications and safety systems, under the following headings:

- Main substation and power distribution systems,
- Emergency and uninterruptible power supply,
- Lighting system,
- Grounding system,
- Lightning protection system,
- Hazardous Area Classification,
- Fire alarm and detection.

In many cases, few significant alternatives exist for consideration in the design development process and these systems will be designed in accordance with pertinent codes and consistent with good industry practice. In such cases, reference is made to the Facility Description (Ref: Monenco Limited[5]), which includes a full description of the system design.

10.2 MAIN SUBSTATION AND POWER DISTRIBUTION SYSTEMS

10.2.1 PURPOSE

The main substation receives the 115 kV supply from Ontario Hydro and transforms it to lower voltages for use in the plant. This power is then distributed to various load centres throughout the plant by the power distribution system.

10.2.2 DESIGN CRITERIA

The system will be designed in accordance with Ontario Hydro Standards and other relevant regulations and codes.

A description of main substation and power distribution systems is provided in the Facility Description (Ref: Monenco Limited[5]).

10.3 EMERGENCY AND UNINTERRUPTIBLE POWER SUPPLY

10.3.1 PURPOSE

The purpose of emergency power supplies is to provide alternative power for essential and critical loads during interruption of normal utility supplies.

Essential loads are those loads which can tolerate a short interruption in power supply but which must be restarted within a certain period of time to ensure safety of human health and the environment, and to avoid damage to equipment.

Critical loads are those loads which cannot tolerate any interruption in power supply, such as computer systems which facilitate control and monitoring of the process.

Essential loads are supplied from standby power systems, such as diesel generators, while critical loads are supplied from uninterruptible power supply (UPS) such as batteries.

10.3.2 DESIGN CRITERIA

Standby and uninterruptible power supplies are required to:

- o run essential processes for a limited time to permit a safe shut down of the plant in the event of utility power supply failure,
- o provide continuous power supply for essential lighting and ventilation systems to ensure safety of plant personnel, and
- o provide an uninterruptible power supply (UPS) to critical control circuits and monitoring systems of the plant.

The design of these systems will be finalized during the detailed design phase of the project.

10.3.3 ALTERNATIVES CONSIDERED

The Institute of Electrical and Electronic Engineers "Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications" (Std 446) - has recommended engineering principles and practices for the selection and application of emergency and standby power systems. These power systems are of two basic types:

- o A reliable power source to which essential loads are switched automatically when the prime source of power fails.
- o An electrical power source, separate from, and operating as a backup should the prime source fail. The generation of power starts automatically in a preplanned sequence to assume the critical loads.

Various types of emergency systems are available, including the following:

- Diesel/Gasoline Engine Generators
- Steam Turbine Driven Generators
- DC Battery Systems
- DC Battery/Inverter Systems (UPS Systems)
- Electric Motor/Flywheel/Alternator/Diesel Engine

10.3.4 EVALUATION OF ALTERNATIVES

The application of the types of systems must be considered in the light of standard industrial practice. No single system is capable of satisfying all plant emergency requirements, so a well proven standard combination of systems is usually evaluated to suit the available resources at a specific site.

Diesel/gasoline engine generators have essentially the same characteristics, both having the advantage of availability as standard package units which are started automatically and run up to speed quickly to provide power for essential loads. The choice of fuel depends on availability and economic factors, although diesel engine drives provide superior starting reliability to gasoline engines.

Steam turbine generators can have economic advantages if there is a surplus of steam in a plant. These units, however, are normally operated continuously rather than on a standby basis as they require warming prior to operation. Steam turbine drives for essential equipment such as pumps are used in certain instances to reduce the power requirements from the standby generator.

DC battery systems have the advantage of immediate availability of power but the required load to be taken by such a system must be limited to avoid an uneconomic installation. These systems are therefore usually used for duties such as circuit breaker switching which do not consume much power.

DC battery/inverter systems operate continuously, using the main supply for normal operation and automatically switching to DC batteries as the power source on power failure. This system is uninterruptible, and is frequently used for critical loads.

An electric motor/flywheel/alternator/diesel engine consists essentially of an alternator with alternate drives at each end of its shaft, the inertia of the flywheel being used to maintain continuity of drive until the standby driver reaches load speed. Both prime movers drive through clutches which enable the non-driving unit to be disengaged. Although this system is capable of providing an uninterruptible supply, it is inherently less reliable than a battery/inverter system because of its mechanical complexity.

For OWMC's Facility the following combination of systems has been selected.

- o DC battery system
- o Self contained DC battery pack units
- o DC Battery/Inverter Systems (UPS)
- o Diesel Engine Generators

10.3.5 DESCRIPTION

DESIGN

A description of the components and uses of the various emergency supply systems follows:

125V DC Battery

This system will consist of DC storage batteries, battery chargers and DC distribution boards.

Lead cadmium or nickel cadmium batteries will be used depending upon economic justification at the detailed engineering stage.

The DC battery system will be located in the main substation building and will provide control power to switchgear, control circuits, fire alarms, communications and emergency lights (if required). The selection of DC loads will be finalized during the detailed design phase of the project.

Self Contained DC Battery Pack Units

These emergency corridor and exit lighting units consist of maintenance free type batteries and small automatic battery chargers.

The units will be installed in areas such as hallways, stairwells and exit doors to ensure a safe evacuation of buildings during a power outage and until an emergency power supply from the diesel generators is available. The battery units will be rated for a minimum of one hour.

DC Battery/Inverter System/Uninterruptible Power Supply Systems

Uninterruptible power supply (UPS) systems provide continuous, disturbance free AC power to critical loads such as computers, sensitive electronic data processing equipment, programmable controllers, communication systems and other control circuits.

A UPS system consists of DC storage batteries, battery chargers, inverter, regulating transformer, and AC distribution boards. This system is capable of operating continuously on line, with no interruption in power when the primary supply source fails.

UPS systems will be located in the incineration plant and physical/chemical treatment plant adjacent to centres of critical load.

Diesel Engine Generators

The diesel engine generator package will consist of two sets of diesel driven generators. Each diesel engine generator set will consist of a diesel engine, governor, air intake and exhaust systems, cooling and lubricating system, fuel oil system and other auxiliary devices together with a generator, automatic voltage regulator, generator exciter, cranking battery, automatic synchronizer, control panel and 600V switchgear.

Diesel - generator sets are produced in nominal size units of 500kW, 750kW or 1000kW, and will be selected to meet the emergency load requirement. The generators will be sized to provide the full starting kVA and running requirements of the emergency load. The diesel-generators will be installed in a non-hazardous area building next to the main substation building.

All essential loads will be supplied from the 600V emergency switchgear through their respective emergency motor control centres located near load centers in the electrical rooms of each process area.

OPERATION

On loss of utility power all critical loads will continue to be supplied, without interruption, from their respective UPS systems.

Both diesel-generator units will automatically start and run up to speed. The lead unit line circuit-breaker will close as soon as terminal voltage is established, while the back-up unit will automatically synchronize with the lead unit and run in parallel. If the lead unit line circuit-breaker does not close within a pre-set time limit the control system will bypass the automatic synchronizer and allow the back-up unit line circuit-breaker to close.

As soon as voltage is detected at each emergency motor control centre (MCC) its automatic transfer switch will operate to energize its emergency bus. Emergency loads will then automatically restart in a coordinated and predetermined sequence, according to priority.

Return of the system to normal utility power will be under manual control.

10.4 LIGHTING SYSTEM

10.4.1 PURPOSE

The purpose of the lighting system is to provide lighting for the safe and efficient operation of the plant.

10.4.2 DESIGN CRITERIA

The lighting system will:

- o provide general indoor and outdoor area lighting,
- o provide working and operating area lighting,
- o provide emergency exit lighting for evacuation during power blackouts, and
- o provide emergency operational lighting during power blackouts of long duration.

The OWMC facility lighting system will be designed with emphasis on safety and energy conservation. Various means to achieve this goal are:

- Optimum lighting levels
- Efficient lighting fixtures
- Automatic/manual block switching

It is stressed however, that energy conservation cannot be achieved by reduction in lighting levels in the production, traffic, process or maintenance areas as this might compromise safety.

Alternative fixture types and illumination levels will be evaluated during the detailed design phase of the project.

10.4.3 LIGHTING APPROACH

The safety and comfort of the plant personnel is of prime importance in the design of the electrical lighting system. Therefore energy conservation will be achieved through the efficient use of lighting control technology and the judicious selection of lighting fixtures.

Lighting levels will generally be based upon the recommendations in the Illumination Engineering Society Lighting Handbook and standard industrial practice.

10.4.4 DESIGN AND OPERATION

The lighting system will consist of the following:

- o Indoor lighting which will include process, production, workshop and office areas.
- o Control room lighting.
- o Outdoor lighting which will include outdoor process areas, parking areas, roads, periphery fence, landfill sites and other surrounding areas as required.
- o Emergency lighting which will include lighting for safe shutdown and monitoring of essential equipment.
- o Emergency exit lighting within all buildings and enclosed areas.
- o Stack lighting.

Emergency lighting will be supplied from the emergency diesel generators, while emergency exit lighting will be supplied from self contained, auto switched battery packs strategically located for safe evacuation during emergencies.

In outdoor areas and production areas, metal halide fixtures are proposed in preference to high pressure sodium to avoid the problems with color rendition usually associated with the latter type.

For office areas, laboratories, locker facilities and other ancillary buildings, fluorescent lights will be used.

Where required, lighting fixture materials will be selected to be resistant to the chemicals present in the environment.

Outdoor lighting fixtures will be chosen so as to direct all illumination onto the designated areas. Lighting backspill will be effectively cut off and be unobtrusive when viewed from outside the plant boundaries.

Stack lighting, if required, will be in accordance with Ministry of Transportation and Communications requirements.

10.5 GROUNDING SYSTEM

10.5.1 PURPOSE

The purpose of the plant grounding system is to provide a physical interconnection of the plant power distribution system and associated electrical equipment to a common ground.

10.5.2 DESIGN CRITERIA

The grounding system must provide the following protection:

- o Limit overvoltages and potential gradients in the plant.
- o Provide for isolation of faulty equipment and circuits if a fault occurs.
- o Ensure the safety of personnel and the protection of equipment.

Ontario Hydro Electrical Safety Code, Sections 36-300 to 36-310 and other sections outline specific requirements applicable to electrical devices and systems; all these code requirements will be met.

The preliminary design of grounding systems is described in the Facility Description (Ref: Monenco Limited[5]).

10.6 LIGHTNING PROTECTION SYSTEM

10.6.1 PURPOSE

The purpose of the lightning protection system is to safeguard personnel, buildings and equipment from the hazards arising from exposure to lightning.

10.6.2 ALTERNATIVES CONSIDERED

Lightning protection requirements are outlined in NFPA 78 Lightning Protection Code and alternatives have not been considered. The selection of equipment for this purpose will be made in the detailed design stage.

10.7 COMMUNICATIONS

10.7.1 PURPOSE

The purpose of the plant communications system is to provide for all communications necessary for safe and efficient operation of the plant.

10.7.2 DESIGN CRITERIA

Communications are required for:

- broadcasting general announcements to all personnel in the plant,
- broadcasting warning signals or instructions to all personnel in the plant,
- direct connections with police, hospitals, ambulances and fire department during emergencies,
- paging key personnel in various areas of the plant,
- telephone calls to conduct normal day-to-day business of the plant,
- supplementary communication system such as beepers and walkie-talkies.

As no single system is capable of satisfying all plant communication requirements. A well designed system will comprise varying degrees of usage of the following:

- o Telephone systems.
- o Public address systems.
- o Personal paging systems (beepers).
- o Multi channel walkie-talkies.

The selection of equipment types will be made during the detailed design stage, and a description of the conceptual design is included in the Facility Description (Ref: Monenco Limited[5]).

10.8 HAZARDOUS AREA CLASSIFICATION

10.8.1 PURPOSE

To identify those areas within the site boundary which can be classified as hazardous in accordance with Section 18 of the Canadian Electrical Code.

10.8.2 DESIGN CRITERIA

All electrical equipment and wiring within areas so classified must be approved for use for the specific classification of that area.

10.8.3 ALTERNATIVES CONSIDERED

No real alternatives exist since basic requirements are outlined in the relevant codes and standards.

Hazardous locations are generally classified as follows:

Class I - Flammable gases or vapors.

Class II - Combustible or electrically conductive dusts.

Class III - Easily ignitible fibers or flyings.

These classes are broadly subdivided as follows:

Division 1 - Material is present under normal operating conditions.

Division 2 - Material not normally present except due to accident on breakdown of equipment.

Generally the main concern will be the handling of organics and liquids containing organics. This will result in Class I Division 1 and Class I Division 2 area classifications. In addition some Class II Division 2 areas (dusts) have been identified.

During the detailed design phase of the project the final location of equipment, installation of separating walls and barriers and the provision of ventilated areas will all have a modifying effect on the classification and locations of hazardous areas which will be finalized in consultation with the loss control consultant.

A summary of the proposed hazardous area classifications is provided in the Facility Description (Ref: Monenco Limited[5]).

10.9 FIRE ALARM AND DETECTION

10.9.1 PURPOSE

The purpose of the fire alarm and detection system is to ensure the safety of personnel by continuously monitoring equipment, plant and buildings for any sign of fire and providing early warnings of fire.

Fire protection and extinguishing systems are covered in Chapter 4 of this report.

10.9.2 DESIGN CRITERIA

The basic requirements for fire alarm and detection systems are covered by The Building Code of Ontario and the National Building Code of Canada.

Specific technical system requirements are outlined in National Fire Protection Association (NFPA) 72A, 72B, 72C, 72D, 72E.

10.9.3 ALTERNATIVES CONSIDERED

There are two basic types of alarm and detection systems:

- Microprocessor - based controller with individually addressable detectors.
- Solid state controller with modular zone monitors.

10.9.4 EVALUATION OF ALTERNATIVES

The microprocessor-based systems represent state of the art and offer considerable advantages over the modular system. Their flexibility, continuous monitoring and checking features and potentially lower installation and maintenance costs make them attractive.

Modular systems on the other hand although not the latest technology are well proven and accepted throughout the industry.

Micro-processor based systems are the currently preferred systems but modular systems will not be excluded from consideration during the detailed engineering phase of the project.

10.9.5 DESIGN AND OPERATION

The fire alarm and detection system essentially consists of a centrally located monitoring station together with detection devices strategically located throughout the plant.

The detection devices will include ionization, photo-electric, thermal, infra-red and ultraviolet detectors as appropriate together with manual pull stations and equipment inputs such as hydrant water pressure, sprinkler systems, automatic doors and ventilation systems.

The central station will continuously monitor each device and verify that all devices are operating within preset limits.

The system will be capable of advising alarm and trouble status, fire locations, recommended actions and initiating direct communications with the fire department.

The fire alarm and detection system will be finalized during the detailed design phase of the project.

CHAPTER 11
SITE SERVICES AND UTILITY SYSTEMS

11.1 INTRODUCTION

This chapter deals with a number of auxiliary systems which support the operation of the main process areas. Site services are generally considered off-site and consist of utilities supplied to the site or discharged from it. The site services addressed in this chapter are:

- o Raw water supply and treatment,
- o water discharged from the site,
- o auxiliary fuel, and
- o electrical power.

The final evaluation of alternatives for the provision of services to OWMC's Facility requires consideration of technical, economic, and environmental factors. This report focuses on the techno-economic factors based on which preferred alternatives were selected for planning purposes with the environmental aspects being addressed by other OWMC Consultants (Ref: Dillon[13]).

Utility systems consist of services distributed throughout the site to supply the needs of the process areas and ancillary buildings. The utilities addressed in this chapter are:

- o Compressed air,
- o steam,
- o service water,
- o potable water, including treatment

- o sanitary sewage collection and treatment,
- o cooling water, and
- o surface drainage.

The sizing of all these systems is preliminary and will be finalized at the detailed design stage.

Furthermore, in some cases, few significant alternatives exist for consideration in the design of utility systems which will be designed in accordance with pertinent codes and good industry practice. In such cases, reference in made to the Facility Description (Ref: Monenco Limited[5]), which includes a full description of the system design.

11.2 RAW WATER SUPPLY AND TREATMENT

11.2.1 PURPOSE

The purpose of this system is to supply and treat all water required for operation of the Facility.

11.2.2 DESIGN CRITERIA

This system will be sized for the initial 150 000 t/a capacity Facility with provision to expand to meet the requirements of a 300 000 t/a Facility.

Where possible, any water used on-site will be recycled to keep raw water requirements to a minimum.

The supply is to be of sufficient quantity, and to be treated to a suitable quality, for potable water, boiler water demineralizer makeup, all service water and cooling water makeup.

11.2.3 ALTERNATIVES CONSIDERED

Three alternatives were considered for water supply:

- Purchase treated water from Grimsby via Smithville and install a pipeline to the site.

- Purchase treated water from Pelham and install a pipeline to the site.

- Pump water from the Welland River and treat it on-site.

11.2.4 EVALUATION OF ALTERNATIVES

Investigation of the alternatives provided the following information:

- The supply of treated water from Grimsby via Smithville would require the construction of a 26 km pipeline from Grimsby. The existing Smithville system does not have sufficient capacity to supply the site.

- The Pelham system has the necessary capacity to supply treated water, but connection to this system would require a 16 km pipeline.

- The Welland River, which is approximately 2 km from the site, provides the closest source of water. As this water is not of potable quality, a treatment plant would be necessary and all pertinent Ministry of the Environment (MOE) regulations would have to be met for the extraction pumping and treatment of the water.

The alternative of using water from the Welland River was selected as it is significantly less costly than the other alternatives and has the added advantage that complete control over the supply is assured. OWMC consultants are to confirm this choice as part of the environmental impacts assessment.

11.2.5 DESIGN AND OPERATION

The raw water treatment system will have a pumphouse located on the Welland River for the supply pumps. The water will enter through a bar screen and traveling screen prior to pumping. The pumps will discharge the water

through a buried pipeline along Heaslip Road into a raw water clarifier located on the site.

The raw water will flow by gravity through the clarifier and sand filter units into a filtered water clearwell, from which it will be pumped to the different users. Chemicals such as alum, polyelectrolyte and pulverized clay will be used to clarify the water, which will also be chlorinated using sodium hypochlorite.

The raw water supply and treatment systems will normally operate automatically and, except for making up some chemicals and periodic checking and testing, the system will not require operator intervention.

The raw water supply pumps in the pumphouse at the Welland River will be controlled by levels in the filtered water clearwell; starting on low level and stopping on high level. The bar screen at the pumphouse is solely to prevent any large objects from entering the pumphouse and will not normally require any operator attention. The traveling screen upstream of the pumps will remove any debris that are too large for the pump to pass. If the screen becomes partialy clogged it will rotate to expose fresh screen and the debris will be automatically removed.

The water will flow through the clarifier and into the filters by gravity. Most solids will settle out and be removed as a sludge in the clarifier, with the clear water flowing to the filter. The chemical feed systems will automatically add the correct concentration of chemicals to cause the coagulation, flocculation and clarification reactions to take place. The chemical feed pumps will start and stop with the raw water pumps and will add the chemicals at a preset rate. The water flow rate through the clarifier will be set by the operator and should not normally require adjustment.

The clarifier, sludge scraper and sludge recirculation systems will operate continuously. Any sludge from the clarifier will be discharged, based on the total feed to the clarifier, to a sump and will be pumped to a tank truck periodically for disposal. The operator must initially connect

the discharge hose and start the pump, which will stop automatically on low level in the sump.

The clarifier water will flow down through the sand in the filter and into the clearwell by gravity. The sand will collect any solids which will be removed by backwashing the filter. The backwash will be automatically initiated either by total flow through the system or high differential pressure across the sand bed. The water used for the backwash will be collected in a backwash sump and pumped back to the clarifier at a low flow rate. The backwash return pumps will start automatically on high level and stop on low level in the backwash sump.

The water flowing into the clearwell will be chlorinated by adding sodium hypochlorite. The metering pump flow rate will be adjusted to give the required dosage and the pump will start and stop with the raw water pumps feeding the clarifier.

The clearwell will hold filtered water which will be pumped to different users as required by their system demands.

System Sizing

The raw water treatment system equipment is designed to treat 900 t/d of raw water and will contain 2 trains, each capable of treating 450 t/d.

The pipeline up Heaslip Road and the pumphouse are designed for 1 800 t/d, including allowance for future expansion of the Facility.

It should be noted that normal plant water demands will be significantly less than the capacity of the water supply and treatment system, due to the use of recycle water on site.

11.3 WATER DISCHARGE FROM SITE

11.3.1 PURPOSE

This system is connected to the storm drainage system described in Section 11.12 of this Chapter. It discharges storm water from the site after it has been tested and proven suitable for discharge.

11.3.2 DESIGN CRITERIA

The main criterion for evaluating alternatives for discharge of water from the site is to minimize impact on the environment by ensuring that offsite discharges are controlled and that no unacceptable contaminants are released to the environment. Therefore, any surface drainage (p. 187) or treated sanitary sewage (p. 183) will have controlled release and be tested to ensure it meets Ministry of the Environment requirements before being released to the drainage system. The system is to be sized for a 300 000t/a capacity Facility.

11.3.3 ALTERNATIVES CONSIDERED

The alternatives considered were:

- o discharge on-site drainage to the Welland River via a sewer down Heaslip Road, and off-site perimeter drainage to existing natural drainage systems,

- o discharge on-site drainage and off-site perimeter drainage to the Welland River via a sewer down Heaslip Road, and

- o discharge on-site and off-site perimeter drainage via a sewer to Sucker Creek, which flows into the Welland River.

11.3.4 EVALUATION OF ALTERNATIVES

Examination of existing surface drainage on the site shows that this does not presently discharge to Sucker Creek, which has a limited capacity and freezes over in the winter. This limitation on winter discharge, as well

as probable restrictions on the discharge of treated sanitary sewage to Sucker Creek, eliminated this alternative.

The alternative of discharging on-site drainage and off-site perimeter drainage via a single sewer to the Welland River is not favoured since the Facility will have no control over the rate of discharge of the off-site perimeter drainage and hence the rate of total discharge to the Welland River.

The alternative of discharging on-site drainage via a sewer to the Welland River and off-site perimeter drainage to the existing natural drainage system is therefore preferred. This alternative also has the benefit of separating on-site from off-site drainage.

11.3.5 DESIGN AND OPERATION

The water to be discharged from the site will come from both the central operating area and the landfill. The design flow is tentatively estimated at 7 000 m^3/h, which would be accommodated by a 48 inch nominal diameter pipe sloped at 0.3%; (Note: flow and sizing to be confirmed after landfill drainage data is available.)

The water will be discharged by a buried gravity sewer which will only require periodic inspection. Any control over the flow or testing of the water will be in the systems which discharge into the sewer.

Off site drainage will be directed around the site, via a perimeter drainage system, to existing surface water drainage courses.

11.4 AUXILIARY FUEL

11.4.1 PURPOSE

The purpose of the auxiliary fuel system is to supply fuel for the on site auxiliary steam boiler, and to meet supplementary fuel requirements for the incineration plant.

11.4.2 DESIGN CRITERIA

Auxiliary fuel is required for operation of the plant auxiliary boilers and for start up and shut down, as well as combustion support purposes, in the incinerator. The main considerations in selecting the type of fuel to be used include gaseous emissions from combustion, cost and reliability of supplies.

11.4.3 ALTERNATIVES CONSIDERED

The following alternatives were considered:

- o No. 2 fuel oil with on-site storage and handling equipment,
- o No. 6 fuel oil with on-site storage and handling equipment,
- o Natural gas via pipeline from Vineland, and
- o Natural gas via pipeline from Pelham.

11.4.4 EVALUATION OF ALTERNATIVES

No. 2 fuel oil is the most expensive of the basic choices for use in the auxiliary boilers and incineration plant and has greater stack emission potential than natural gas.

No. 6 fuel oil was eliminated due to the unacceptable sulfur emmission from the stack.

The initial installation of a natural gas pipeline to site will be more expensive than oil storage and handling facilities, but this disadvantage will be offset by cheaper fuel cost and reduced plant maintenance. Stack emissions from the combustion of natural gas will be the least of any alternatives.

The foregoing reasons led to the choice of natural gas as the preferred auxiliary fuel, following confirmation by Provincial Gas that a pipeline could be provided to the site from Vineland rather than from

Pelham. As this will ensure a highly reliable supply, the requirement for a standby source was not considered necessary.

Opportunities for operating cost savings, by the use of fuel oil to reduce peak natural gas requirements during certain operating conditions, will be further investigated during detail design, in conjunction with negotiations on the natural gas supply contract.

11.4.5 DESIGN AND OPERATION

Natural gas will be supplied by Provincial Gas via a buried pipeline along Regional Road 24 from Vineland, and along Highway 20 to the site. This will be sized for the quantity required, which is tentatively sized at 403×10^3 GJ/a, based on a heating load of 124 GJ/h, for a 300 000 t/a Facility. The pipeline will terminate at a metering station and a pressure regulating valve will be installed to reduce the supply pressure to that required at the equipment burners. This pressure regulation will be automatic and will not require any operator attendance other than periodic inspection.

11.5 ELECTRICAL POWER

11.5.1 PURPOSE

The purpose of this system is to supply electrical energy to the site, the on site distribution system being addressed separately in Chapter 10.

11.5.2 DESIGN CRITERIA

As this system only applies to the delivery of electricity by Ontario Hydro to the site the only applicable criterion is that the powerline be sized for a 300 000 t/a Facility. The consideration of alternatives is restricted to the routings of the transmission line to site.

11.5.3 ALTERNATIVES CONSIDERED

The following alternatives were considered:

- Transmission line from existing 115 kV line along Silverdale Road to site.

- Transmission line from existing 115 kV line along possible future rail spur to site.

11.5.4 EVALUATION OF ALTERNATIVES

The routing along Silverdale Road was selected for preliminary design purposes, as the installation of a rail spur to the site is not initially being considered.

11.5.5 DESIGN AND OPERATION

Electrical power will be supplied from a 115 kV power line tapped off Ontario Hydro's 115 kV Q2A circuit, which supplies Dunnville Transformer Station, and brought into the main OWMC substation from the north. The electrical load is presently estimated at approximately 10 MVA and will be confirmed during the detail design stage. This portion of the system will not require any operation other than periodic inspection.

11.6 COMPRESSED AIR

11.6.1 PURPOSE

Compressed air is produced on-site and distributed as required for instrumentation, process area needs, and pneumatic tools. It may also be used for ventilation of confined working areas during maintenance of equipment.

11.6.2 DESIGN CRITERIA

The following criteria were established as a basis for the design of the compressed air system:

- Provide oil free air for the system.
- Include driers to maintain a dew point of -40°C or less at full line pressure.

- o Provide filters upstream and downstream of driers.
- o Size supply equipment for a 150 000 t/a Facility with headers suitable for 300 000 t/a capacity.

11.6.3 ALTERNATIVES CONSIDERED

No alternatives for compressed air were considered. Within the design of the system, however, safety aspects dictated the choice of particular methods of ensuring that instrument air requirements are giving priority in the event of compressor shutdown for any reason. This is achieved by:

- o Providing three compressors, each sized for 50% of the total air requirement or the total instrument air requirement, whichever is greater.

- o Providing separate mains for instrument air and plant air downstream of the air driers: The plant air branch will include an isolating valve which will shut when the pressure in the instrument air line falls below a certain value. Separate reservoirs are included for plant air to allow some continuity before shut-down.

- o The nitrogen system is not used as a back-up for the compressed air system because of a possible breathing hazard to operations personnel entering vessels.

The design of the plant compressed air system is described in the Facility Description (Ref: Monenco Limited[5]).

11.7 STEAM AND CONDENSATE SYSTEMS

11.7.1 PURPOSE

The purpose of this system is to generate and distribute all steam required on-site, and to accommodate steam generated as a by-product from the incineration process.

The steam and condensate systems are addressed in the Process Area Report - Incineration (Ref: Monenco Limited[6]) and further described in the Facility Description report (Ref: Monenco Limited[5]).

11.8 SERVICE WATER

11.8.1 PURPOSE

The purpose of the service water system is to supply water to meet on site process requirements.

11.8.2 DESIGN CRITERIA

Service water is required for process, flushing and general requirements throughout the Facility. Recycle water from the physical/chemical treatment plant will be used, when available, to minimize make-up requirements drawn from the filtered water clearwell. As the service water system will contain recycle water, it must not be discharged to the surface water ponds.

Service water headers are to be sized for a 300 000 t/a Facility with all other equipment such as pumps sized for the initial 150 000 t/a capacity.

No significant design options were considered for this system, which therefore is described in the Facility Description (Ref: Monenco Limited[5]).

11.9 POTABLE WATER SUPPLY AND TREATMENT

11.9.1 PURPOSE

The purpose of this system is to produce and distribute potable water throughout OWMC's Facility.

11.9.2 DESIGN CRITERIA

Potable water is required for use by personnel as well as eyewash/safety showers and all sanitary facilities. It must meet all Ministry of Health and Ministry of the Environment requirements for potable water quality and be available even in the event of a power failure.

The distribution system will be sized for a 300 000 t/a Facility.

11.9.3 ALTERNATIVES CONSIDERED

Three alternatives were considered for this system:

- o Produce potable water from treated raw water on-site,
- o Purchase potable water from Grimsby via Smithville and install a pipeline to site.
- o Purchase potable water from Pelham and install a pipeline to site.

11.9.4 EVALUATION AND SELECTION

The first alternative is the most economical as the additional equipment required to treat the on-site raw water is minimal. The selection of this alternative is therefore a corollary of the selection of obtaining the raw water from the Welland River, as detailed in Section 11.2 of this Chapter. This selection also avoids constructing an additional pipeline to the site.

11.9.5 DESIGN AND OPERATION

The potable water system will be supplied from the filtered clearwell (p. 176) by one of three potable water pumps which will discharge into a pressurized surge tank to even out peak flows from the system. Sodium hypochlorite will be added to the water for disinfection purposes.

The potable water system will normally operate automatically and, except for periodic checking and testing, it will not require any operator intervention.

The pressurized storage tank will be controlled at approximately 415 kPa gauge by applying compressed air to the tank, which will supply the potable water header.

The potable water system will be provided with emergency power so that it can operate even if there is a major power failure.

System Sizing

The potable water system will be designed to supply 30 m^3/h and a flow of $24m^3/d$ for the 300 000 t/a facility.

11.10 SANITARY SEWAGE COLLECTION AND TREATMENT

11.10.1 PURPOSE

The purpose of this system is to collect and treat all sanitary wastes produced on site.

11.10.2 DESIGN CRITERIA

The system is to be sized for a 300 000 t/a Facility. If sewage is to be treated on site the Ministry of Environment requirements for the discharge of treated effluent will be met.

11.10.3 ALTERNATIVES CONSIDERED

The following alternatives were considered for this system:

- Install a packaged treatment plant on-site and discharge treated effluent to the Welland River via a storm sewer along Heaslip Road.
- Install a packaged treatment plant on-site and solidify treated effluent for disposal in the landfill.
- Install a packaged treatment plant on-site and evaporate the treated effluent to atmosphere.
- Pump raw sewage to Grimsby via Smithville.

11.10.4 EVALUATION AND SELECTION

The first alternative will require a treatment plant on site to meet Ministry of the Environment requirements and a 2 km pipe for discharge to the Welland River. This is the most economical alternative.

The second and third alternatives are more expensive than the first alternative based on a preliminary analysis of capital and operating costs.

The fourth alternative would not require the on-site treatment plant but would entail a 24 km pipeline to Grimsby via Smithville and is, for this reason, the most expensive.

The first alternative was selected as it is the most economical, avoids a tie-in with existing facilities at Grimsby and only entails pipeline construction for a relatively short distance.

11.10.5 DESIGN AND OPERATION

The sanitary sewage will be collected on site by gravity in one of two package unit pumping stations and then pumped by buried pipeline to a package sewage treatment plant.

The sewage treatment plant will consist of an aeration tank with two blowers and a number of non clog aerators, a clarifier to remove any sludge, and a chlorination system designed to add sodium hypochlorite to maintain a residual chlorine.

The treatment plant will also have a surge tank, two pumps to pump the effluent to disposal and an aerated sludge digester to store and break down some of the excess sludge prior to disposal. The aerobic digester will take air from the aeration tank blowers.

The sanitary sewage collection and treatment systems will operate automatically and will only require operator intervention for testing and routine maintenance.

There will be two pumping stations to collect all sanitary sewage produced in the central operating area. The different sanitary facilities will discharge by gravity sewer into the wet well of one of the pumping stations, from which pumps will deliver the collected sewage to the sewage treatment plant based on the level in the wet well.

The sewage will be pumped to an aeration basin where biologically activated sludge will react with the sewage, collect any solids and break down any organic matter into carbon dioxide, water and more biologically active sludge. Air will be added to the aeration basin to keep the microbial population alive.

The contents in the aeration basin will overflow into a clarifier. The sludge that settles out will be pumped back to the aeration basin and the clean liquid will overflow into the chlorination chamber.

Sodium hypochlorite will be added to the chlorination chamber to disinfect the effluent from the clarifier. The sodium hypochlorite will be added from a metering pump that will start when there is a flow to the sewage treatment plant and stop when there is no flow.

The chlorinated effluent will overflow into a holding tank. It will then be pumped to final disposal.

Extra biological sludge will be produced in the aeration basin, the excess being pumped into an aerobic digestor where it will be aerated and approximately 50% of the sludge will break down. Periodically the sludge in the aerobic digestion unit will be pumped to a tank truck for disposal off site at a municipal sewage treatment plant.

System Sizing

There will be two sewage lift stations, one sized for 30 m^3/h and the other for 20 m^3/h. The treatment plant will be designed to treat 24 m^3/d.

11.11 COOLING WATER

11.11.1 PURPOSE

The purpose of this system is to provide cooling water as required to mechanical and process equipment, and to remove any heat pickup so it can be reused for cooling purposes.

11.11.2 DESIGN CRITERIA

The system is to use raw water from the filtered clearwell (p. 178) with chemical addition as necessary to control scaling and/or corrosion.

The headers are to be sized for a 300 000 t/a Facility with equipment sized for 150 000 t/a capacity.

11.11.3 ALTERNATIVES CONSIDERED

Although alternative sources of the cooling water are not practical, different methods of extracting the heat from the returning water are available:

- Use of the firewater pond for cooling part of the load and other means for the remaining duty.
- Use of cooling towers only.

As the water in the system is not contaminated, there are no restrictions on evaporation with either method of cooling. The first alternative is preferred as part of the duty will be accomplished by the firewater pond although the whole system will be reviewed at the detailed design stage when more factual details of all cooling requirements will be available from equipment suppliers.

11.11.4 DESIGN AND OPERATION

The cooling water system will have two pumps to recirculate cooling water through the process units and some air conditioning systems in their areas. This water will then be cross exchanged with cool water from the firewater pond to remove any excess heat. Water from the firewater pond will be recirculated by one of two pumps through a heat exchanger and back into the firewater pond, which will act as a natural cooling pond by discharging heat to the atmosphere.

The firewater pond will not have sufficient cooling capacity for all of the cooling water on site so some of the water for air conditioning will be cooled using other means.

The cooling water system will operate automatically and will only require routine maintenance.

Since some of the heat in the firewater pond will be removed by evaporation the level of the pond will be maintained by adding treated service water from the filtered water clearwell.

System Sizing

The total heat duty of the cooling water system is estimated at 192 x 10^6 kJ/d and the firewater pond is suitable for approximately 50% of this duty. The remainder must be cooled by cooling tower.

11.12 SURFACE DRAINAGE

11.12.1 PURPOSE

The purpose of the surface drainage system is to provide facilities to manage the surface runoff from precipitation and road wash in the central operating area. It will also collect and manage any fire water and/or chemicals resulting from a fire incident and/or on site spill. The landfill drainage system is collected and managed in a separate system which is described in the Process Area Report - Engineered Landfill (Ref: Monenco Limited[9]).

11.12.2 CRITERIA

As this system will collect drainage from a variety of sources on site, the fundamental criterion for design is that no surface water will be discharged from the central operating area without being tested to ascertain that it meets all discharge criteria. This is to ensure that OWMC's goals of minimizing risk to human health and environmental impact are implemented.

This criterion led to a basic decision to separate the drainage systems in the central operating area from those of the landfill. The former is to be provided with positive drainage throughout the central

operating area and be separated from the landfill drainage by surface grading and earthworks.

Each collection point in the operating area was then examined to determine whether contamination of the drainage was possible and under which circumstances this would happen. The development of the system concentrated on separating sources in order to minimize the quantity of water which would require treatment, if it became contaminated. This development resulted in the decision to have three surface drainage systems, namely:

- o Uncontaminated
- o Potentially contaminated
- o Contaminated

The uncontaminated system manages the precipitation from the roofs of buildings and grassed areas of the central operating area. The potentially contaminated system manages the precipitation mainly from roadways and other parts of the plant where contamination of surface water is possible but unlikely. The contaminated system covers all process areas with outdoor operating equipment and the drainage from such areas is not directed to a surface water pond, but rather collected locally in sumps, from where it is pumped for treatment. Overflows from these sumps are connected to the potentially contaminated drainage system.

For these systems the following criteria were established:

- o Provide sewers and surface water ponds sized for the ultimate plant capacity of 300 000 t/a. Sewer connections will be provided for the expansion from 150 000 t/a to 300 000 t/a.

- o Size the sewers for a 25 year return period storm or a two year return period storm plus firewater.

- Provide surface water ponds for the uncontaminated and potentially contaminated surface drainage system that are designed to hold a 3 day 100 year return period storm or total firewater, whichever is greater.

- Separate the contaminated system, which covers all active process areas prone to spills during plant operation, from the other two systems.

- Provide double liners on the surface water ponds.

- Discharge uncontaminated water from the surface water ponds to the Welland River at a rate that will empty the entire pond in 5 days. Both ponds to be capable of discharging together.

- Discharge contaminated water from the surface water ponds to the physical/chemical treatment plant at a rate that will empty an entire pond in 10 days should the collected water require treatment. Only one pond to discharge at a time.

- Base the flows on runoff coefficients of 0.95 for pavement and roofs, 0.60 for gravel surfaces and 0.20 for grassed areas.

- Receive overflow from within buildings resulting from deluge, sprinkler system or the use of firehoses.

11.12.3 ALTERNATIVES CONSIDERED

No alternatives were considered other than the basic concept of separated containment previously described. A full description of the Facility surface drainage systems is included in the Facility Description (Ref: Monenco Limited[5]).

CHAPTER 12
VENT EMISSION CONTROL SYSTEMS

12.1 PURPOSE

The purpose of vent emission control systems is to minimize the release of contaminants to the environment due to the release of vent gas and exhaust air from process equipment and process building areas of OWMC's Facility.

12.2 DESIGN CRITERIA

The criteria established for the design of vent emission control systems required that:

- o emission control systems should be installed wherever required, to control the release of fugitive emissions to the environment throughout OWMC's Facility,
- o the design of emission control systems must minimize the risk to human health and to the environment, due to the release of contaminants,
- o both organic and inorganic gaseous emissions must be controlled, and
- o residual emissions shall, as a minimum, meet regulatory standards in Ontario.

12.3 ALTERNATIVES CONSIDERED

The control of fugitive particulate (dust) emissions from many parts of OWMC's Facility can be effectively managed using conventional equipment and following industry practice. Examples include the use of fabric filters to control the release of particulate material from the vents of reagent storage silos and from the vent air of dry solids handling enclosures (Ref: Monenco Limited[8]).

This section of the report deals with alternative systems considered for the control of organic gaseous and inorganic emissions from various parts of the Facility.

Alternatives considered for the control of organic emissions include:

- o destruction in the rotary kiln incinerator,
- o destruction by catalytic oxidation,
- o removal by compression and chilling, and
- o removal by activated carbon.

Alternatives considered for the control of inorganic emissions include:

- o water scrubbing, and
- o water scrubbing with addition of acid or caustic reagents.

12.4 EVALUATION OF ALTERNATIVES

12.4.1 ORGANIC EMISSION CONTROL

It was determined that wherever possible, the emissions vents from organics should be discharged to the rotary kiln incinerator since this would effect a highly efficient means of destruction with minimal incremental capital and operating cost. However, the limited capability of the incinerator to

accept vent streams required that only the most contaminated vents be sent to the incinerator. Also, auxiliary scrubbing systems are required whenever the incinerator is out of operation.

The main characteristics of the remaining organics emission control systems are as follows:

- o Catalytic Oxidation
  - suitable for low concentrations of organics,
  - involves elevated temperature (300°C),
  - requires auxiliary fuel such as natural gas,
  - most suitable for continuous gas releases,
  - requires a well defined gas stream,
  - catalyst easily poisoned by chlorides, fluorides and heavy metals.

- o Compression and Chilling
  - most effective for highly contaminated gas streams,
  - most suited to continuous gas releases.

- o Activated Carbon
  - suitable for low concentrations of organics,
  - does not involve heating or cooling equipment (providing regeneration is not included),
  - simple design, without moving parts,
  - suitable for continuous and intermittent gas streams,
  - suitable for a wide range of gas flow,
  - limited performance data on some contaminants,
  - spent carbon must be replaced.

Catalytic oxidation was eliminated from consideration since many vent streams are intermittent, and the gas composition cannot be well defined due to the variability of materials being treated at OWMC's Facility. The

possibility that some contaminants could poison the catalysts was a further factor in the elimination of this option.

Compression and chilling was eliminated since most of the highly contaminated gas streams for which this process is most suitable will be directed to the incinerator for destruction. Most remaining streams involve large quantities of air having low organic content for which this process is unsuited. The intermittent flow characteristics of most streams was another factor, since the process is not amenable to frequent startup/shutdown.

Activated carbon was selected as the preferred option because of its flexibility in effectively treating both continuous and intermittent, high and/or low gas flows, plus its inherent simplicity resulting in high operational reliability. The system is also suitable for low concentrations of organics which are present in many of the Facility's vent streams.

These advantages were considered to outweigh the possibility for rapid exhaustion of the activated carbon media arising from the occassional treatment of the more concentrated gas streams, since such streams will normally be directed to the incinerator.

Activated carbon is also suitable for use in the removal of low concentrations of organics in the vents from inorganic treatment areas of OWMC's Facility.

Overall, the combination of incineration for the destruction of contaminants in highly concentrated vent streams, plus activated carbon for the removal of organics from low concentration vent streams, was considered to best meet OWMC's objectives in minimizing risk to human health and impact on the environment, by controlling organic fugitive emissions from OWMC's Facility.

12.4.2 INORGANIC EMISSION CONTROL

The main characteristics of the inorganic emission control options are as follows:

- o Water Scrubbing
  - suitable for water soluble contaminants,
  - suitable for continuous and intermittent gas releases,
  - simple single stage design.

- o Water Scrubbing with Reagent Addition
  - suitable for less water soluble contaminants,
  - suitable for a wider range of contaminants,
  - suitable for continuous and intermittent gas releases,
  - multi-stage scrubber design.

It was determined that water scrubbing would be used in most applications for OWMC's Facility involving the unloading and storage of waste, and that the more flexible but complex multi-stage scrubber with reagent addition be used for the control of emissions from process equipment, including process reactors and emulsion breaking units, since the likelihood of gas production due to process reactions is greatest in these units.

12.5 DESIGN AND OPERATION

This section addresses the design and operation considerations of vent emission control systems at OWMC's Facility.

12.5.1 ORGANIC EMISSION CONTROL

Vent gases from the following equipment will normally be sent, via a flame arrestor, to the rotary kiln incinerator for destruction of organic contaminants:

- o Organic waste receiving tanks at the bulk waste unloading station (p. 75).
- o Organic waste storage tanks at the incinerator tank farm (p. 97).
- o Organic waste blending tanks at the incinerator tank farm (p. 97).
- o Organic waste vacuum tanks at the organic drum handling facility (p. 117).
- o Aqueous organic waste storage tanks in the physical/chemical tank storage area.

The organic waste receiving tanks, storage tanks and blending tanks will all be under nitrogen blanket to reduce fire and explosion hazards and the pressure controlled automatically between 14 and 70 kPa gauge. Volume changes in these tanks due to pump-in or pump-out of waste, or due to temperature fluctuations, will be balanced within the tank groups and will normally result in pressure fluctuations within the established range stated above. The release of vent gas (nitrogen) to the incinerator will only be necessary occasionally, due to large increases in the volume of waste received.

Dual activated carbon adsorbers will be provided to handle the vent gases from these systems when the incineration plant is out of operation. The dual system permits continued operation while activated carbon media is being replaced in one unit.

The nominal removal efficiency for activated carbon adsorbers is expected to be 90%.

Vents from the segregated organics storage tanks in the incinerator tank farm (p. 97) will be handled in an identical manner to that described above, normally venting to the incinerator. The vents from these tanks will be kept separate from others, however, because of the particularly toxic nature of wastes which may be stored in these tanks and the desirability of isolating these materials to the maximum extent possible.

Ventilation air from the drum sampling and active process area of the organic drum storage and handling building (p. 115) will be routed to dual activated carbon adsorbers, for the removal of contaminants prior to the discharge of air to atmosphere.

The in ground organic waste receiving tanks (p. 73) will be equipped with three separate vent systems to effectively control fugitive emissions and ensure operator safety. The first system consists of a high volume ventilation canopy over the receiving tank to minimize the escape of fugitive emissions during unloading. The ventilation air is directed to dual activated carbon adsorbers prior to being released to atmosphere, and the system will only be operated during unloading operations. The second system involves a much lower flow rate and provides continuous ventilation of the tank during pumpout and standby operations. This system also includes dual activated carbon adsorbers for contaminant removal. The third system provides ventilation to the concrete pit which contains the receiving tank, and is provided to avoid the accumulation of vapours which could cause an explosion or be injurious to operator health. The vent from this pit will be normally directly to atmosphere since organic contamination is expected to be minimal.

12.5.2 INORGANIC EMISSION CONTROL

This section deals with vent emission control systems associated with the receiving, storage and treatment of inorganic waste. While the contaminants in vent gas will be predominantly inorganic, it is likely that some organic constituents may also exist and for this reason all inorganic emission control systems include wet scrubbing for the removal or inorganic contaminants followed by an activated carbon adsorber for the removal of trace organics.

The removal efficiency of wet scrubbers is expected to be better than 90% for all normal operating conditions.

The in ground inorganic waste receiving tanks (p. 81) will be equipped with three separate vent systems to effectively control fugitive emissions and ensure operator safety, similar in concept to the system previously

described for in ground organic waste receiving tanks. The systems will comprise a high volume ventilation system for the capture of fugitive emissions during unloading, a low volume system for the containment of emissions during pumpout and/or standby conditions, and a third ventilation system to prevent the accumulation of hazardous vapours in the pit which houses the receiving tanks. The first two systems will have separate two stage emission control system comprising water scrubbers and dual activated carbon adsorbers arranged in series. Ventilation systems can be separated to provide collection and vent gas scrubbing for receiving tanks dealing with acidic wastes, and a system dealing with alkaline wastes.

The ventilation air from the drum sampling and active process areas of the inorganic drum storage and handling building (p. 125) will be routed to a two-stage emission control system comprising a water scrubber followed by dual activated carbon adsorbers, for the removal of contaminants prior to the discharge of air to atmosphere.

The following process equipment in the physical/chemical treatment plant (Ref: Monenco Limited[7]) will be connected to a two-stage emission control system comprising a multi-stage scrubber with reagent addition followed by dual activated carbon adsorbers for the removal of contaminants prior to the discharge of air to atmosphere.

- o Storage Tanks
- o Reactors
- o Emulsion Breaking Tanks
- o Dissolved Air Flotation Units

A single vent emission control system will be provided for the organic and inorganic truck wash stations (p. 91). The air from exhaust hoods and truck tanks will be combined with the vent gas from wash liquid tanks, and will be vented to atmosphere through a two-stage emission control system comprising a water scrubber followed by a dual activated carbon filter.

12.5.3 OPERATING CONSIDERATIONS

The main operating considerations of the vent emission control systems are:

- Regular monitoring of system performance will be performed to ensure that systems are working effectively, to make adjustments to scrubber liquor quality if required, to monitor carbon adsorber temperature and to schedule replacements of activated carbon media.

- Replacement of activated carbon media will be pre-scheduled and either incinerated onsite or sent to an approved facility for regeneration.

- Liquid effluent from the vent scrubbers will be held in storage tanks and processed in the physical/chemical treatment plant.

CHAPTER 13
BUILDINGS AND STRUCTURES

13.1 INTRODUCTION

This chapter deals with four components of the Facility subjects which are ancillary to the operation of the main process areas, namely

- o administration building,
- o gatehouse,
- o maintenance facilities, and
- o piperacks.

The following sections examine these subjects in a similar manner to that of the previous chapters although the approach to the design is only outlined here pending the finalization of requirements, during detailed design.

13.2 ADMINISTRATION BUILDING

13.2.1 PURPOSE

The purpose of the administration building is to provide accommodation for all on-site administrative functions as well as the main laboratory and data management services.

13.2.2 DESIGN CRITERIA

The following criteria were established for developing a physical layout of the administration building:

- Provide office space for senior management, marketing, accounting, office services and first aid.

- Locate the main laboratory so that laboratory staff have easy access to and, if possible, sight of truck holding and unloading areas. Special laboratory requirements in respect of safety and venting are detailed in Chapter 8 (p. 134).

- Provide facilities for truck drivers awaiting the results of the analysis of their truck contents.

- Provide changing facilities for plant personnel, located so that access is not through the general office area.

- Provide climate controlled rooms for main computer hardware.

- Provide lunchroom for office staff.

- Provide reception area for visitors.

- Provide conference and/or display rooms.

13.2.3 ALTERNATIVES CONSIDERED

A number of preliminary layouts of the building were considered to arrive at an approximate floor area to meet the design requirements. While the estimate of this area is about 2 700 m^2, it may vary depending on the numbers of on-site staff. At this stage, the alternatives considered were single or double storied buildings.

13.2.4 EVALUATION OF ALTERNATIVES

As this building, apart from the laboratory section, will not be directly affected by waste and can be of conventional construction, the main factors in evaluation are convenience of operation, cost and visual appearance.

Its location in the central operating area has been discussed in Chapter 3, resulting in a site location between the organic and inorganic processing areas and adjacent to the main entrance. While both single and double storied buildings could be accommodated in the layout, the former would occupy a far larger area.

With respect to cost it is estimated that a two storey building would be 10 - 15% cheaper than a single storey structure of equivalent area.

A two storied building is also preferred from an aesthetic point of view as this will be the principal focus of attention for all people approaching the Facility and will be architectually designed for visual appeal.

For these reasons the double storied building has been selected although the general size, shape and internal arrangements will be reviewed at the detailed design stage.

13.2.5 DESCRIPTION

The building will probably be a reinforced concrete framed structure with concrete panels or insulated preformed metal panels applied to the exterior wall surface.

The preliminary layout is based on the following approach:

- All general areas, operations facilities and staff personnel will be located on the ground floor with senior office staff the upper floor.

- Operating personnel facilities will be on the ground floor at the north end of the building to separate them from the general office

areas. These facilities will include clean and dirty locker rooms/ linen areas, showers and washrooms.

- Main computer hardware rooms will be climate controlled.

- Laboratory areas will have special venting systems and climate control as required. Further details of the main laboratory are provided in Chapter 8.

13.3 GATEHOUSE

13.3.1 PURPOSE

The purpose of the gatehouse is to provide accommodation and facilities for security personnel controlling the main entrance and exit from the site.

13.3.2 DESIGN CRITERIA

The following criteria define the functions which are to be provided from the gatehouse:

- Entrance/exit barriers and weighscales to control and check details of all vehicles requiring access to the Facility.

- Computer terminal having access to daily delivery schedule with a data entry facility for vehicle details.

13.3.3 ALTERNATIVES CONSIDERED

The purpose and approach to the gatehouse are conventional and any alternative details will be considered at the detailed design stage.

13.3.4 DESCRIPTION

The gatehouse will be a single storey, rigid steel channel frame building approximately 13 m x 4 m in size, located on an island between the entrance/exit lanes at the main gate of the Facility. Separate incoming

and outgoing weighscales will be positioned in the roadway near the gatehouse to enable the security personnel to check and record vehicle weights as well as visually inspecting for leaks or trailing waste.

Facilities in the gatehouse will include:

- communications equipment consisting of a telephone, a computer terminal, and
- washroom for security staff.

13.4 MAINTENANCE BUILDING

13.4.1 PURPOSE

The purpose of the maintenance building is to provide the necessary space, tools and materials for on-site maintenance of process equipment and plant vehicles.

13.4.2 DESIGN CRITERIA

It is intended that process equipment and routine vehicle maintenance will be carried out on site, while functions such as the servicing of vehicle hydraulics or machine shop work will, in line with OWMC policy and, wherever practical, be contracted out to local businesses.

13.4.3 ALTERNATIVES CONSIDERED

Consideration of the size and contents of the maintenance building will be reviewed during the detailed design phase when the extent of on-site maintenance requirements will be more clearly defined.

13.4.4 DESCRIPTION

As presently envisaged, the maintenance building will be a steel framed structure with insulated metal siding, approximately 52 m x 25 m x 5.5 m high. It will include accommodations for the following:

- o Offices for superintendent, and maintenance foreman.

- o Technician/draftsperson, buyer, clerk/typist and storekeeper.

- o Mechanical, electrical and instrumentation and control workshops with facilities for routine maintenance and some emergency repairs. The instrumentation and control workshop will have an area with climate control for maintenance of delicate instrumentation.

- o Stores and spare parts areas.

- o Vehicle bay for emergency vehicles, snow clearing equipment and minor plant vehicle maintenance.

13.5 STORAGE BUILDING

13.5.1 PURPOSE

The purpose of the storage building is to provide temporary storage of organic and/or inorganic waste pending exact determination of an appropriate treatment and disposal method.

13.5.2 DESIGN CRITERIA

OWMC's Facility provides for the receipt, storage and treatment of authorized waste on the basis of the waste characteristics. It is, however, possible that OWMC may, from time to time, receive wastes which differ from that authorized initially or for which arrangements have been made for delivery and safe storage pending determination of treatment method.

The following criteria were established for temporary storage:

- o All wastes to be stored temporarily must be containerized, such as in drums or top-sealed containers.

- The storage building will be located within the core zone of the central operating area.

- The quantities and/or frequency of receipt of such waste can vary.

Therefore, it has been decided, on confirmation of the Facility layout, to provide as much space as practicable for this building area while remaining within the core zone.

- The layout must be developed to satisfy operability, fire safety and environmental protection requirements.

13.5.3 ALTERNATIVES CONSIDERED

The purpose and function of the storage building has been established in the previous sections. Alternative details will be considered at the detailed design stage.

13.5.4 DESCRIPTION

The maximum size of building which can be accommodated within the core zone measures approximately 23 m x 55 m or 1265 m^2. A utilization factor of 50% has been assumed, providing an area of 630 m^2 for storage of waste in containers.

On this basis, temporary storage capacity at any given time, for waste in different types of containers, will be approximately as follows:

- 140 top-sealed containers measuring 1.5 m x 3 m x 2 m (9 m^3), equivalent to 1260 m^3 of waste (weight quantity will depend on bulk density of waste), or

- 1000 drums of 200 L nominal capacity each, with 4 drums to a pallet (250 pallets), placed in a single level (no stacking) equivalent to 200 m^3 of waste, or

- a floor area of 630 m^2 to place contaminated equipment on trays of suitable dimensions, or

- any combination of the above that can be accommodated in an area of 630 m^2.

The building will be single storied to ensure easy access for placement and retrieval of waste containers and will be heated for freeze protection. Details of building type and other design features will be addressed during the detailed design stage, but the building will have controlled access.

The operating philosophy will be to clear the inventory of material in temporary storage as quickly as is feasible, so that maximum area is available to receive new consignments. To this end, the following guidelines would apply:

- Waste received will be sampled and characterized as quickly as possible.

- Treatment methods will be determined based on treatability tests.

- The batch of waste will be scheduled for treatment in the appropriate process system as soon as possible, including operating additional shifts of inorganic systems and/or treating these wastes as a priority over regular, authorized waste for which adequate storage is available elsewhere on the Facility.

13.6 PIPE RACKS

13.6.1 PURPOSE

The purpose of the pipe racks is to support and provide access to all waste, process and utility pipes and cable trays.

13.6.2 ALTERNATIVES CONSIDERED

The primary alternatives for pipe routing are elevated or buried services, as pipes at ground level lead to congestion around operating equipment.

Further alternatives exist in the materials used to construct the pipe racks, such as concrete or steel, and these options will be evaluated in the detailed design stage.

13.6.3 EVALUATION OF ALTERNATIVES

With the exception of certain water services such as fire mains, it is preferrable to have elevated pipes which permit easier access for inspection, repair and/or modification. This is particularly important for waste piping, where frequent inspections will be required to ensure that even minor leaks or drips are rapidly detected and repaired.

13.6.4 DESCRIPTION

Pipe racks will generally be supported by columns every six metres and contain up to three tiers, depending on the area and the number of pipes. Intermediate horizontal supports will be provided as required for all pipes, with personnel access ways between tiers for inspection and maintenance. Any cable trays supported by the racks will always be above the top tier of pipes.

In certain areas, where recommended by the OWMC's underwriters, the rack will be fireproofed up to, but not including, the top surface of the beams supporting the lowest tier.

REFERENCES

1. The Proctor & Redfern Group. 1982. Generic Process Technologies Studies.

2. Ontario Waste Management Corporation. (OWMC) 1982. Facilities Development Process: Phase 1 Report.

3. Ontario Waste Management Corporation. (OWMC) 1984. Facilities Development Process: Phase 3 Report.

4. A.D. Little of Canada Limited. 1985. Rationale for the Selection of Technologies for the Treatment and Disposal of Special Wastes in Ontario.

5. Monenco Limited. 1986. Facility Description.

6. Monenco Limited. 1986. Process Area Report - Incineration.

7. Monenco Limited. 1986. Process Area Report - Physical/Chemical Treatment.

8. Monenco Limited. 1986. Process Area Report - Solidification.

9. Monenco Limited. 1986. Process Area Report - Engineered Landfill.

10. M.M. Dillon Ltd. 1984. Site Selection Process, Phase 3B: Selection of Candidate Sites - Facilities Characteristics and Technical Buffer Zone.

11. Ontario Waste Management Corporation. (OWMC) 1983. Facilities Development Process: Phase 2 Report.

12. Monenco Limited. 1986. Site Selection Process, Phase 4A: Selection of Preferred Site(s) - Engineering.

13. M.M. Dillon Ltd. 1986. Comparative Evaluation of Phase 4B Servicing Options.

GLOSSARY OF TERMS

AQUEOUS ORGANIC WASTE: Liquid waste which contains organics with significant proportions of water.

BASIS OF DESIGN: The criteria on which the design of the treatment process or system is based, including incoming waste quantity and characteristics, treatment objectives, facility capacity, mode of operation, process reliability, etc.

BOILER BLOWDOWN: That portion of the water in the boiler's steam/water circulatory system that is discharged to maintain the concentration of total solids (dissolved and suspended) at predetermined levels.

COMBUSTION: The process of converting inherent chemical energy in a substance to heat and light energy through oxidation at elevated temperatures.

CATALYST: A substance whose presence increases the rate of chemical reaction.

CEMENT: Generic term describing any inorganic material which fastens things together as it hardens.

CONTAMINANT: Any solid or liquid chemical element or component individually or in combination which may:-

- impair the quality of the environment or the public therein for any use that can be m-de of it,
- cause injury or damage to property or plant or animal life,
- cause harm or material discomfort to any person,
- adversely affect the health or impair the safety of any person, or
- render any property or plant or animal life unfit for use by man.

DETOXIFICATION: Treatment of materials to remove, immobilize or destroy toxic components.

EFFLUENT: Liquid streams resulting from complete physical/chemical treatment of wastes, unless otherwise qualified. Synonymous with Treated Effluent.

INCINERATION: The thermal destruction of waste by oxidation at elevated temperatures.

INORGANIC WASTE: Waste predominantly composed of inorganic materials such as naturally occurring minerals.

ORGANIC WASTE: Waste predominantly composed of elements that are oxidizable and therefore capable of thermal destruction by icnineration. Organic materials originate from living things such as trees, animals, etc.

OXIDATION: A chemical reaction where molecules or atoms of oxygen are combined with molecules or atoms of another substance. In this report, oxidation is always used to represent oxidation at elevated temperatures, i.e. thermal oxidation.

PHYSICAL/CHEMICAL TREATMENT PROCESSES: Physical/chemical treatment processes commonly refer to processes whose main operating principles involve either physical treatment, chemical treatment or some combination of both physical and chemical treatment.

POLLUTANT: Synonymous with contaminant.

POLYMER: A substance composed of giant molecules formed by the union of a large number of simple molecules (Monomers). The process of forming a polymer is called Polymerization.

PRODUCTS OF COMBUSTION: Products of the combustion process other than the heat and light energy released. These products include flue gases and any solid residues.

RESIDUE: Solids, semi-solid or liquid materials remaining after incineration of organic waste and physical/chemical treatment of inorganic wastes, or as a waste product of other processes.

SEGREGATED ORGANIC WASTE: Certain organic wastes such as Poly Chlorinated Biphenyls (PCB's) and pesticides that require special handling and storage.

SOLIDIFICATION: The process by which chemically rective formulations and components in the waste form stable solids which will not revert to the original liquid or semi-liquid state under conditions anticipated in the landfill.

STACK: The vertical structure that contains the cylindrical duct or flue used to convey and discharge the cleaned flue gases to atmosphere.

SYSTEM: The assembly of equipment, piping, instruments, electrics, foundations and structures into an installation in which process treatment is executed.

TREATMENT: When used in connection with hazardous waste, means any method, technique, or process, including neutralization, designed to change the physical, chemical, or biological character or composition of any hazardous waste so as to neutralize such waste or so as to render such waste less or non-hazardous, safer for transport, amenable for recovery, amenable for storage, or reduced in volume.